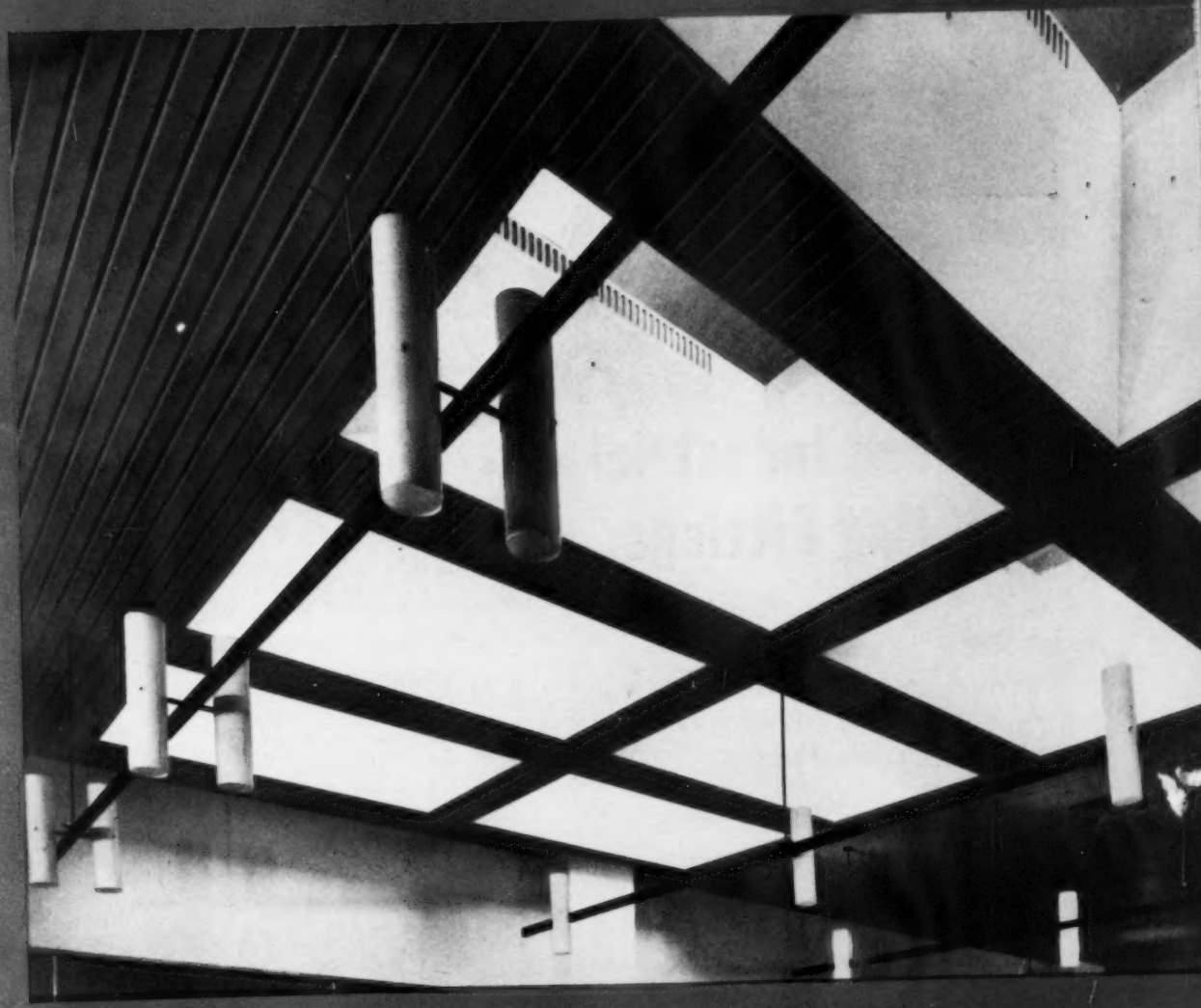
2s. 6d.

Light and Lighting

March 1960



In the staff restaurant of Castrol House—new London headquarters of the Wakefield Castrol Group of Companies—lighting is from cylindrical fittings of opal glass, fixed to a suspended steel grid serving also as conduit for the supply cables. (See pages 60-63.)

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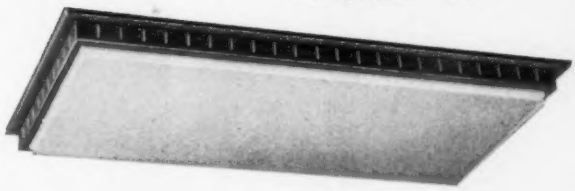
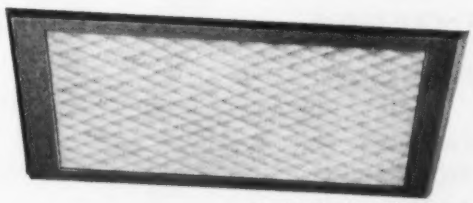


2″ Drop Frame — 4′ x 2′

3″ Drop Frame — 4′ x 2′



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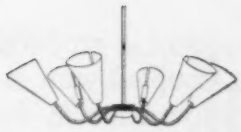

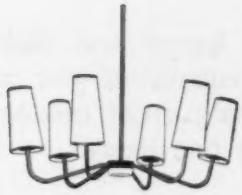

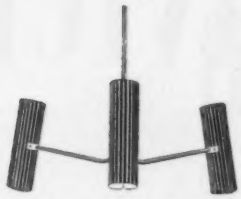

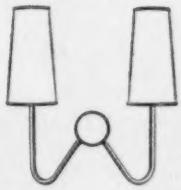

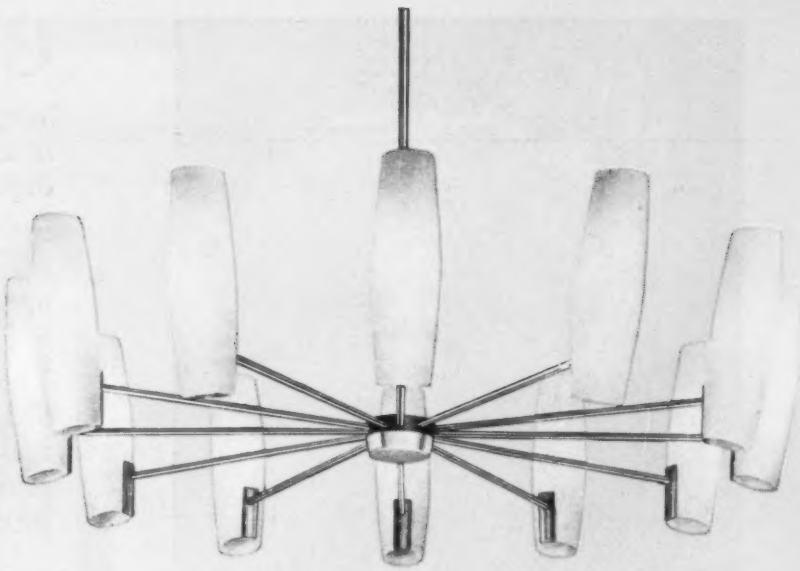

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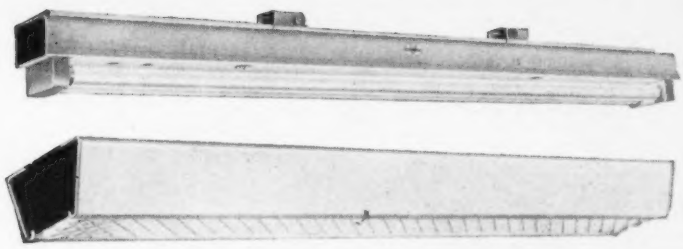
Service by Bearer, Nigeria (Photo J. Allan Cash)



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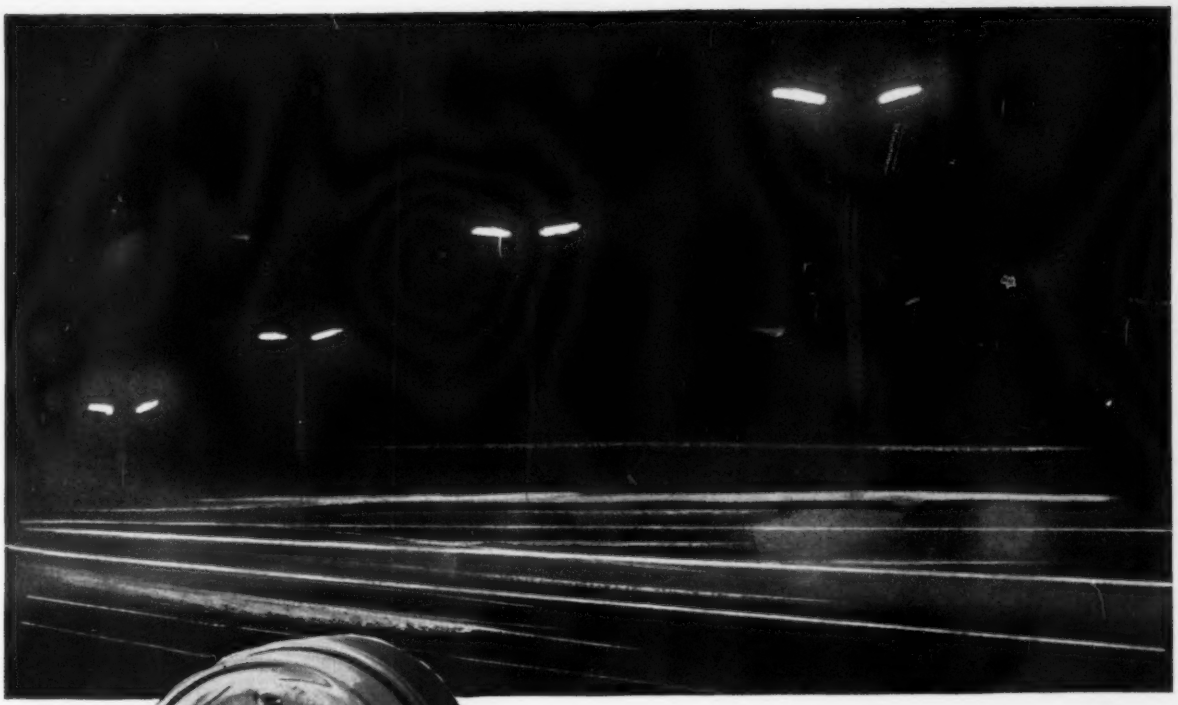
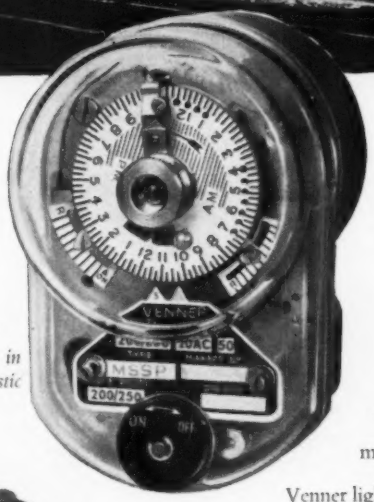


Still Streets ahead!



Type MSSP
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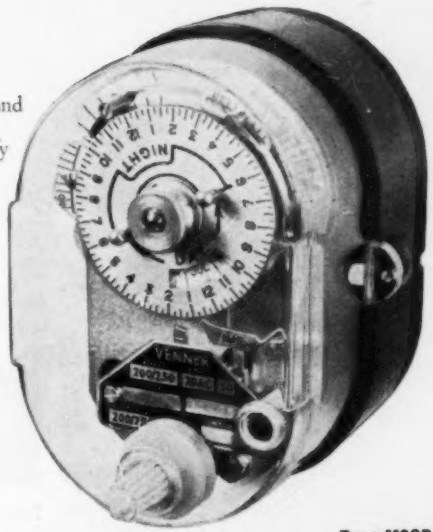

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Vol. 53 No. 3

Light and Lighting

CONTENTS

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Light for Production

FACTORIES are not the only places in which a product results from human endeavour, and those engaged in activities that do not consist in making parts of what are called consumer and capital goods are not unproductive workers. The products of order clerks are filled out forms, and the products of typists are letters. Neither of these are saleable to customers, yet they are products necessarily involved in getting saleable products. Everyone engaged in production depending upon the use of the eyes needs proper lighting, but this by no means involves only adequate illumination. Nor does adequate illumination necessarily mean a great deal of light. Production is sometimes better facilitated by quite modest illumination plus proper directing of the light on to the work in hand than it would be by much higher illumination less skilfully applied. Then there is the matter of suitable spectral composition of the light. Local lighting, whether produced by nearby or remote light sources, has tended to go out of fashion in these days of fairly high general illumination in factory and office workrooms but it is still a valuable aid to productivity in some cases. However good the general lighting may be it cannot always penetrate to critical places sufficiently and, of course, it may not be most effective where modelling is most helpful. The best lighting for production may only be devised after closer study of the work to be done than can usually be made by the lighting engineer. Users of lighting ought themselves to help in this matter for no one should know better than they what particular visual problems their work presents.

Notes and News

IN SEPTEMBER, 1957, at the request of carpet manufacturers the Council of Industrial Design organised a tour of Northern Italy for directors, design executives and designers which proved very successful. As 1960 is the year not only of the Milan Triennale but also of the Venice Biennale exhibition of modern art, it has been suggested by several manufacturers that a similar tour be planned for a wider range of industry for late September, 1960, and the CoID has agreed to organise one. The Milan Triennale is of particular importance on such a tour because it is the most important international exhibition of industrial design with representation from most of the leading countries of the world.

The tour will again be for two weeks, with travel from London to Milan by air, in Italy by motor coach, and return by air from Venice. Leading Italian architects and designers will be co-operating and two members of the CoID staff will be assisting. It is hoped to make up a party of 30 members from such industries as lighting, plastics, carpets, textiles, pottery and furniture. The cost will be £140 each, which includes air travel tourist class, full board and accommodation at selected hotels grade II, and all gratuities and incidental travel charges. Full details of the proposed tour and copies of the itinerary can be obtained from the Industrial Division, Council of Industrial Design, 28, Haymarket, London, S.W.1.

National Illumination Committee

AT THE RECENT ANNUAL general meeting of the National Illumination Committee of Great Britain new officers were appointed for the next four years, i.e. for the period until after the next meeting of the International Commission in Vienna in 1963. The new chairman of the NIC is Mr. W. R. Stevens, and the vice-chairmen are Dr. W. E. Harper and Mr. J. G. Holmes. Mr. E. B. Sawyer continues as Hon. Treasurer and Mr. L. H. McDermott will continue the good work he has done for a number of years as Hon. Secretary.

Retiring from the NIC after many years of service are Dr. English, who was chairman for the last four-year period, and leader of the British delegations at the international meetings in 1948, 1951, and 1955, and Mr. F. C. Smith, who had served on the NIC since 1935, was a vice-chairman for 13 years and was deputy-leader at the 1951 and 1955 meetings.

A Colloquium on Street Lighting

THE AFTERNOON OF November 25 saw a gathering at the Palais des Congrès in Brussels of some 300 representatives of the many professional and technical organisations interested in the promotion of good street lighting. It was arranged by the Association de l'Eclairage Public and in the seven papers presented the subject was treated from a number of different angles. For example, M. Ghijsels of the Via Secura (Society for the Prevention of Accidents) spoke of the needs of the road user and M. J. B. Johansen gave some statistics of road accidents. Fatalities on the road, he said, were twice as numerous as those in the workshop. The points of view of the police, of the municipality and of the central administration were explained in papers by members of those various authorities.

M. Boereboom used to advantage his knowledge of the subject and his many international connections, as the author of a paper on the street lighting situation in countries outside Belgium. He dealt especially with the relation between the local authority and the central government department in the matter of financial responsibility for street lighting. In Germany, as in this country, such responsibility rests solely on the local authority and the situation is the same in Switzerland and in Finland where, however, there is no street lighting outside the towns. In France there is a considerable degree of government aid and in the Netherlands the state may pay the whole or part of the cost of lighting a particular road. In Belgium the lighting in towns is the responsibility of the municipality, but the state may light inter-urban thoroughfares.

At the conclusion of the colloquium a number of resolutions were passed. Several of these dealt with the way in which responsibility for street lighting should be shared among the various authorities, but there was also a resolution urging that 750 kilometres of main roads (excluding autoroutes) should be lighted within the next five years. Street lighting experts everywhere, not least the members of the APLE, will doubtless watch with interest the results of this pressure being exerted by the ABEP in favour of more adequate expenditure on street lighting.

The road-worthy test line at the new Ford plant at Dagenham.
A feature on this plant will appear in a future issue.

CASTROL HOUSE

New H.Q. for Wakefield Castrol Group

CASTROL House, the new headquarters of the Wakefield Castrol Group of Companies is in Marylebone Road, London, W.1, between Baker Street and Edgware Road and immediately facing St. Marylebone Town Hall. The building covers a site of nearly an acre, having been built by Sir Robert McAlpine & Sons Ltd. for the owners, the Hammerson Group of Companies. Wakefield Castrol's move to the new building from offices which for many years have been dispersed in several buildings in Grosvenor Street, W.1, coincided with three anniversaries in the firm's history: the centenary of the birth of its founder, the late Viscount Wakefield of Hythe; the diamond jubilee of its foundation and the fiftieth anniversary of the introduction of its best-known product—Castrol.

The building, which was designed by Gollins, Melvin, Ward and Partners, in association with Sir Hugh Casson and Neville Condor and Associates, covers the entire site to a height of two floors, with a third floor set back. Above this, at the west end of the site, a 12-storey glass tower rises to a height of 168ft., providing a total floor area of 165,300 sq. ft., with a plot ratio of 3.5 to 1. The height of the tower block was restricted because of the proximity of the tower of St. Marylebone Town Hall. But for this, the third floor accommodation would have been added to the tower block, thereby increasing the visual impact of the building.

The scheme represents, in fact, a compromise between a simple rectangular building running parallel to Marylebone Road (to conform with the wishes of the Royal Fine Arts Commission for a corridor street) and the original conception of a tower block with a patio to which the public would have had access—as at Thorn House.

One of the principal features of the building is the two-storey entrance hall. Along the Marylebone Road frontage there is a 60ft. long canopy and the entrance hall is screened from the road by large areas of plate glass in stainless-steel and aluminium framing. Inside, walls are finished with white Sicilian marble and with orange mosaic, while the floor is of Belgian fossil marble on the ground floor and Burma teak strip (carried through as the roof covering of the canopy) on the first floor. A dominant feature is a 50-ft. long and 24-ft. high relief wall sculpture in cast aluminium designed by Geoffrey Clarke, ARCA, which covers the entire width of the rear wall extending the full height of both floors.

Left, general view of building as seen from St. Marylebone Town Hall. Top, main entrance showing luminous ceiling of first floor foyer, and the 60ft.-long entrance canopy, with its illuminated sign.

Right, main entrance with change of level from floor to pavement emphasised by recessed cold-cathode tubing covered by 'Armourplate' glass. Lighting in the soffit of the canopy is from four rows of semi-recessed cylindrical fittings housing 60-watt mushroom-shaped lamps. Below, rear of entrance hall, where similar fittings give general illumination level of approximately 10 lm/ft², while recessed eyeball spotlights highlight the sculpture mural.

On both floors the lift shaft is clad with orange mosaic and the recessed entrances are faced with satin-finish, vertically-ribbed aluminium.

The concrete structure of the building comprises standardised columns to three basic sizes; walls for lift enclosures and fire-cells that have, wherever possible, been incorporated into the structural design; and flat floor slabs, with no downward projecting beams to complicate the shuttering or the installation of services. In addition, two 12-in. thick diaphragm walls run east/west across the tower to provide rigidity.

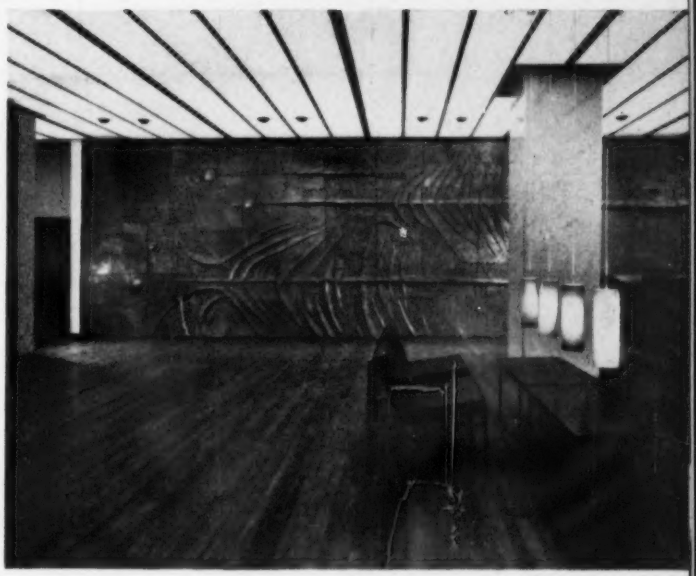
It was decided from the outset to enclose the building completely with aluminium curtain walling. For the low block, this comprises black-anodised mullions at approximately 8ft. centres, connected by deep natural-anodised transomes, sills, etc. The window inserts consist, in the main, of horizontally-sliding sashes, while the spandrel panels are mostly of white Sicilian marble. The curtain walling to the tower consists of a deep anodised-aluminium grid, with vertically-sliding sashes and spandrel panels of ¼in. "Calorex" glass.

The lighting installation, for which the consultants were Edward A. Pearce and Partners, is unusual in that the principal light source is cold-cathode tubing—throughout the

Left, typical office area lit by luminous beams housing twin rows of cold-cathode tubing, photo-electrically controlled according to the outdoor illumination level. Below left, special fitting in boardroom, supplementing general lighting from tungsten fittings with square 'Perspex' covers as described in text. The fitting comprises a 'race-way' of extruded aluminium, anodised black, supporting spun-aluminium cylinders and concealing the wiring. The cylinders each house two 60-watt tungsten lamps and are black anodised outside and white painted inside.

office areas, for the exterior lighting, and for all areas lit by luminous ceilings. Office lighting is from luminous beams, with covers of diamond-pattern "040" " Perspex", with the pattern on the outside. This was chosen in preference to plain opal "Perspex" because, with the latter, fingermarks and other stains tend to show up prominently against the sheen of a long length of the material.

Continuous recessed troughs house twin 22mm, 120 ma tubing, with the covers projecting 2in. below ceiling level. These covers are about 12in. wide, replacing five widths of the perforated aluminium ceiling strip, which, in combination with sound-absorbent material above, acts as an acoustic ceiling. On the lower floors the luminous beams run east/west, while in the tower they run north/south. In both instances, this at right angles to the demountable partitions dividing the office areas, the junctions between adjacent lengths of "Perspex" cover being arranged to coincide with possible partition positions (level with the mullions of the façades). Where a partition cuts across a luminous beam, the covers flanking it are replaced by shorter lengths cut to fit neatly against the partitioning.



Right, staff canteen, with lighting from cylindrical opal glass fittings, each housing two 60-watt lamps, fixed to nine suspended channels of black-painted drawn steel. To achieve the desired lighting level—about 12 lm/ft²—every other row comprises pairs of cylinders, while the remaining rows have single cylinders fixed to alternate sides of the channeling. Below right, first floor foyer. In the foreground, suspended low over the occasional tables, are fittings with green glass cylindrical shades as used over desks in private offices. Glass-fibre diffuser panels of the luminous ceiling are trimmed around the eyeball spotlights suspended level with these panels.

In the tower there are three luminous beams on one side of the corridor and two on the other, the lighting being switched on and off by relays photo-electrically controlled by the outdoor illumination level. In addition there is manual over-riding control of some beams for the convenience of cleaners, etc. The intended illumination level is 25 lm/ft², the current reading, with new lamps and clean equipment, being 30 lm/ft².

For corridors, circulation areas, most private offices, lavatories and cloakrooms, a recessed fitting housing a 150-watt tungsten lamp has been used. It is fitted with a 12in. square "Perspex" diffuser to the same profile as the covers of the luminous beams.

The main ground floor entrance hall is lit by rows of semi-recessed fittings each comprising a spun-aluminium cylinder, stove-enamelled black inside and out, housing a 60-watt mushroom-shaped lamp, the bottom of which is level with the base of the cylinder. Four rows each of 20 similar fittings are part-recessed into the soffit of the entrance canopy, which continues, past the "Armourplate" doors and adjacent floor-to-ceiling windows, the ceiling level of the entrance hall. Fully recessed into the entrance hall ceiling is a row of adjustable eyeball spotlights directed on to the sculpture mural to accentuate its form.

The first floor of the entrance hall has a luminous ceiling, its main framework, constructed *in situ*, comprising aluminium channels, anodised black, at 7ft. 6in. centres, with the diffuser panels supported at 1ft. 10in. centres by aluminium tees, anodised natural. The diffusing medium is off-white corrugated glass-fibre sheeting, chosen because the void is heated and "Perspex", which would otherwise have been used, could not be guaranteed dimensionally stable under this condition.

The void is 16in. deep and houses continuous rows of cold-cathode tubing at 3ft. 8in. centres, this wide spacing not causing uneven flashing because of the high density of the diffusing medium.

Careful attention was given to the intensity of light provided by this luminous ceiling. Firstly, because good lighting was needed over the staircase and, secondly, because it was necessary to ensure that, at ground-floor level, that part of the mural lit only by the luminous ceiling would be lit to the same intensity as the remainder.

Lighting in the lift lobbies on each floor of the tower is from lengths of cold-cathode tubing recessed into the ceiling adjacent to the lift entrance and covered by panels of corrugated glass-fibre sheeting. The lighting is switched on automatically—in the appropriate area—on the arrival of one of the lifts. In these lobbies, there is no problem due to ceiling heating and it is a pity that "Perspex" diffusers were not used, as the relatively small areas and low ceiling height make more noticeable the somewhat thick and clumsy profile of the glass-fibre sheeting.

Virtually the only other type of lighting fitting to be found inside Castrol House is a tungsten fitting with a cylindrical green-glass shade. A row of these fittings hangs low over the occasional tables on the first floor of the entrance hall; others hang over the desks in the private offices.

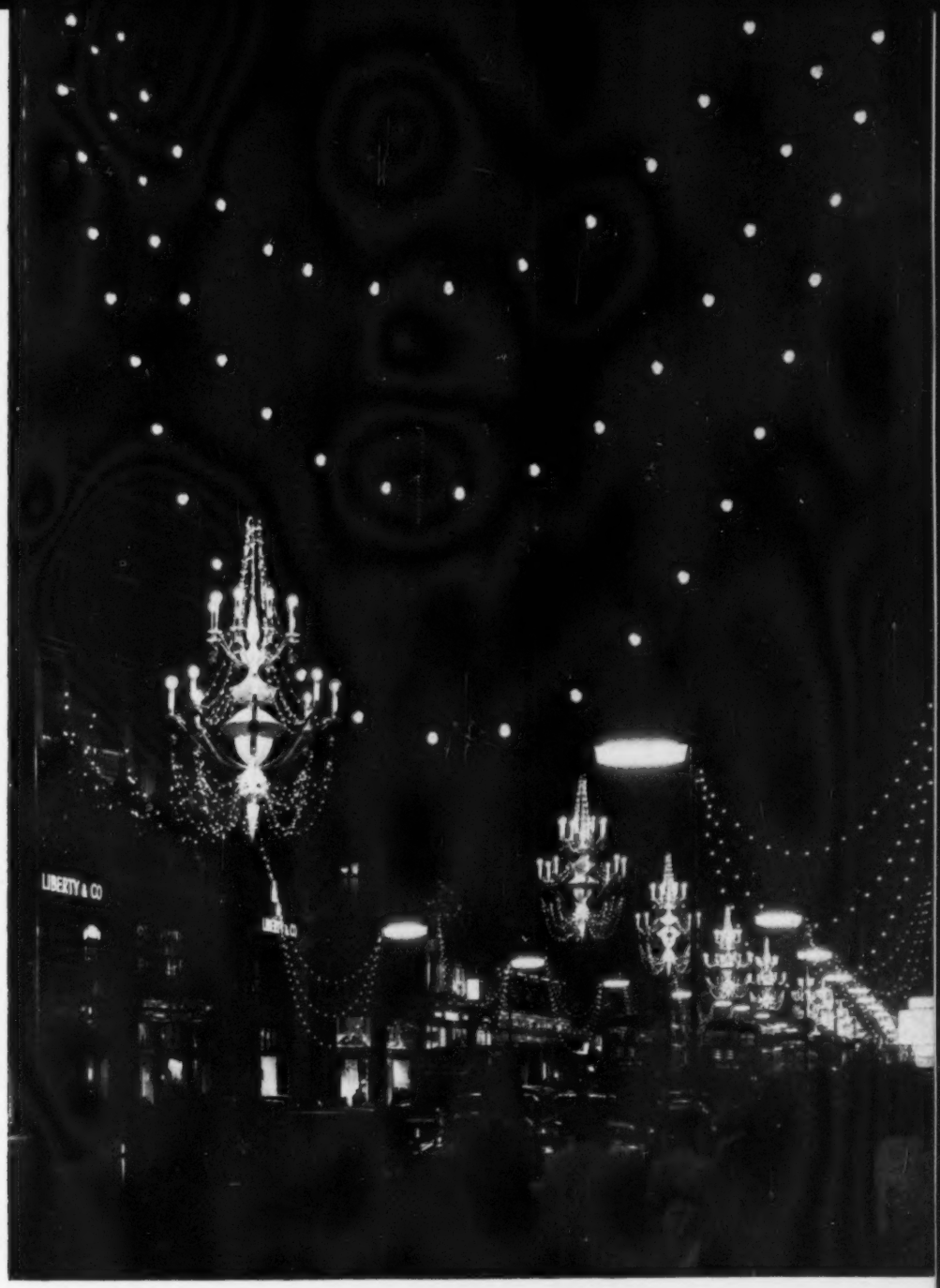
Exterior lighting, switched on every evening from half-an-hour before sunset to 11 p.m., comprises a 4ft. length of green cold-cathode tubing at the base of each spandrel panel of the tower. These panels are of green-tinted glass and the lighting creates at night fourteen green bands of light around the building. The tubing is under-run, being operated at 60ma instead of 120ma, to reduce what proved to be excessive brightness and to improve the colour—originally a rather too-vivid emerald green.

Electrical installation, Electrical Installations Ltd.; all cold-cathode fittings, including luminous ceilings, Ionlite Ltd.; special fittings in entrance hall, board-room and staff restaurant, Courtney, Pope (Electrical) Ltd.; other tungsten fittings, Fredk. Thomas and Co.

Street Lighting, Christmas, 1959

THE increasing commercialisation of Christmas is deplored by many people. Christmas street lighting schemes, sponsored by traders associations and chambers of commerce, and aimed partly, at least, at increasing the sales of shopkeepers in the streets concerned, may be considered as part of this process. These schemes can, on the other hand, be looked upon as a manifestation of something that goes back in history long before the birth of Christ. For the Christmas festival almost coincides with the winter solstice and it is, surely, significant that candles have always played a dominant part in Christmas decorations. They may be taken to symbolise the passing of the longest night of the year and the promise of longer hours of daylight—an occasion celebrated by peoples of all lands and all beliefs. It is, for example, no coincidence that the Jewish festival that celebrates the Maccabean revolt, which also occurs within a few days of the winter solstice, is known as the 'Festival of Lights' and marked by the lighting of candles at sunset on seven consecutive days. It is to be hoped, therefore, that no one will be offended by these four pages of photographs of street decorations in connection with Christmas, 1959. The most elaborate of the schemes illustrated is that of London's Regent Street. As in previous years, this scheme was designed by Beverley Pick, FSIA, and is undoubtedly the most ambitious that the Regent Street Association has yet attempted. It may well be described, in fact, as one of the most outstanding decorative lighting installations ever seen. It is of interest to note that some of the elements of the scheme have been purchased by traders in the smallest of the four towns whose street decorations are illustrated for use in 1960. This town—Northampton —used for its 1959 scheme Regent Street's decorations from the previous year.

Regent Street's Christmas lighting has for some years been an outstanding attraction for Londoners and others visiting the City at this time of the year. In 1959 a more elaborate scheme than on previous occasions was made possible because the authorities concerned permitted for the first time the installation of lighting fixtures suspended over the roadway. These comprised 25 chandeliers at 100ft. intervals, each 25ft. high and 100ft. in diameter. They were each festooned with 32 separate strings of twenty 4-watt 'permanent contact' lamps. (They short across if they burn out, so that other lamps are not disconnected.) In the centre body of each chandelier there were ten 60-watt, six 100-watt and six 150-watt lamps, and the 16 'candles' enclosed 60-watt lamps, with 100-watt lamps for the flames. In addition, there were some 20,000 fairy lights festooned from lamp standards to the adjacent buildings. (Designer, Beverley Pick, FSIA; makers, Chrysaline Ltd.)



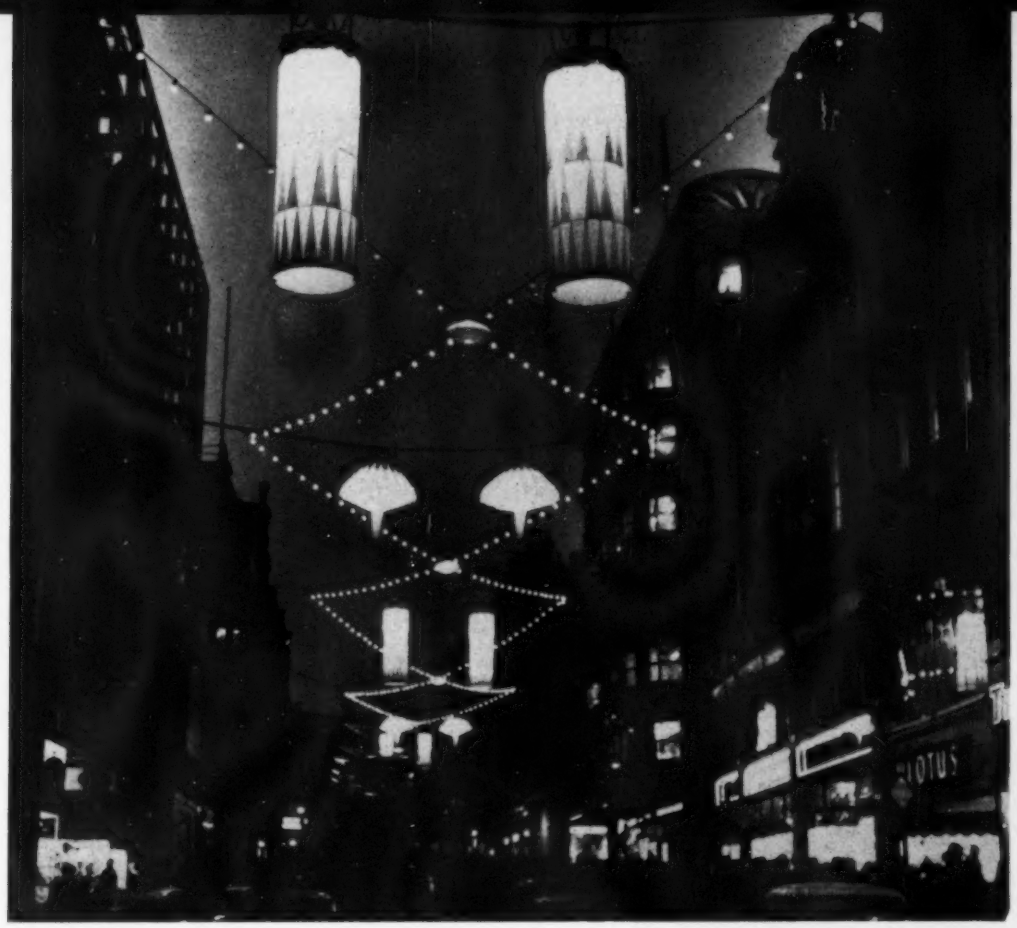
LONDON

Opposite page: Under the auspices of the Oxford Street Association, Oxford Street shops combined for the first time in a scheme of street decorations. This scheme by Gillian Greenwood, MSIA, formed part of a large-scale publicity campaign aimed at establishing Oxford Street as 'the greatest shopping street in the world.' Centre-of-the-road lamp standards were enclosed by triangular frameworks of coloured panels and lamps for the entire 1¼ miles of the street's length. Right: Bond Street's scheme, promoted by the Bond Street Association, comprised a coronet, 5ft. 6in. in diameter and 2ft. 6in. high, mounted on each of the main lamp standards and suspended over the roadway at the Piccadilly end of the street where there are no lighting standards. Designed by Martin and Jane Priestman, the coronets (made of papier-maché and painted with 'Day-glo' paint) each housed two rings of 150-watt lamps.

MANCHESTER

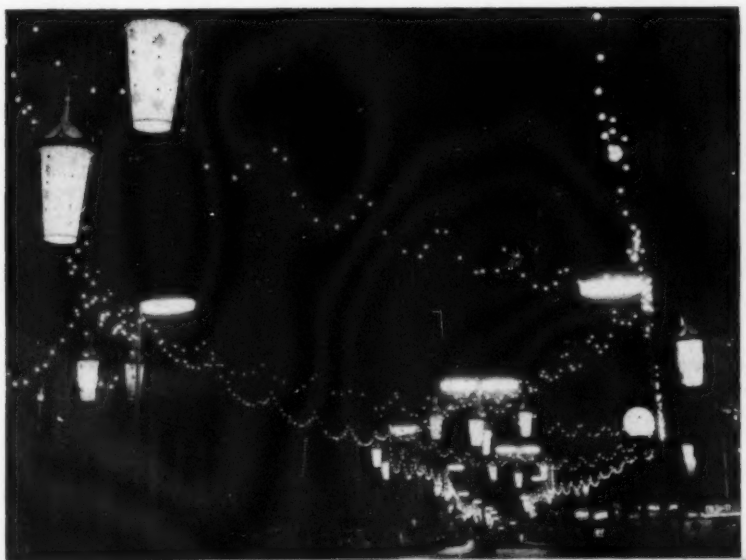
An extensive scheme of floodlighting and decorative lighting was designed and installed by the Street Lighting Section of the City Surveyor's office. It included the floodlighting of the Town Hall (left) with sodium vapour lamps directed on to the façade and with tungsten projectors directed on to the towers. Near the Town Hall was a 60ft. high tree, festooned with lamps and floodlit from below by a continuously changing sequence of coloured lights. The central library has a permanent decorative lighting installation incorporated in its structure. For Christmas, this installation was supplemented by sodium floodlamps behind the pillars of the main entrance. Piccadilly Gardens were festooned with lamps and various figures from fable and fairy tale were floodlit, as below and below left.

Street Lighting, Christmas 1959 (*continued*)



BIRMINGHAM AND NORTHAMPTON

Birmingham's City Centre (above) had a scheme paid for by shopkeepers on the basis of 35s. per ft. run of frontage. Made from steel rods and 'Chrysaline' plastic, the main lanterns were suspended from the overhead lighting catenaries. Some 1¼ miles of festooned lamps linked these lanterns, while over the New Street/Corporation Street junction a symbolic Christmas tree was suspended. Fixed to lamp standards and floodlit were (right) various faces and figures of clowns and pirates, 'fiendishly jolly and larger than life.' They were made of sheet steel, in the form of paper sculpture. (Architects, Norrish and Stainton, with K. V. Norrish and Alex Jackson responsible for detailed design.) Below, Northampton's Abingdon Street scheme, incorporating the Regent Street (London) decorations of 1958, purchased by local traders for the sum of £5,000.



Fluorescent lighting in an Australian Textile Mill, providing 25 lm/ft² on the 45 deg. working plane. (Lighting planned by Claude Neon Ltd. in co-operation with technical staff of Burlington Mills Pty. Ltd.)

Lighting and Productivity

A Summary of an I.E.S. Golden Jubilee Lecture by A. N. Irens, M.Sc., M.I.E.E.

THE view that good lighting can improve industrial productivity is so widely held among lighting engineers that it is often forgotten (1) that many industrialists have yet to be convinced and (2) that there is, in fact, comparatively little statistical evidence available to support the view. Many factories and workshops today have lighting installations that would have been considered primitive a quarter of a century ago, and it is to be hoped, therefore, that the recent lecture on Light and Productivity by A. N. Irens, MSc, MIEE, will be widely disseminated.

Mr. Irens gave some cogent arguments in favour of good industrial lighting, quoted a number of case histories and suggested a form of questionnaire that could be used to assemble more information on the changes that take place when lighting schemes are improved.

Speaking to a lay audience mainly of industrialists and businessmen at one of the IES Golden Jubilee Meetings, Mr. Irens dealt first with the vast improvement in efficiency that has taken place in lamp output—from the 8 lm/watt of the 'half-watt' lamp introduced just before the 1914-18 war to the 15-20 lm/watt of the modern tungsten filament lamp and the 40 and 60 lm/watt, respectively, of mercury and sodium-vapour lamps. He mentioned also the development of the colour-corrected mercury lamp, which avoids the unpleasant greenish colour, usually associated with these lamps, and the 'linear' sodium lamp for street lighting, which can give around 100 lm/watt—some ten times the amount of light that could be obtained 50 years ago for the same current consumption.

Mr. Irens paid particular attention to improvements in fluorescent lamps, using

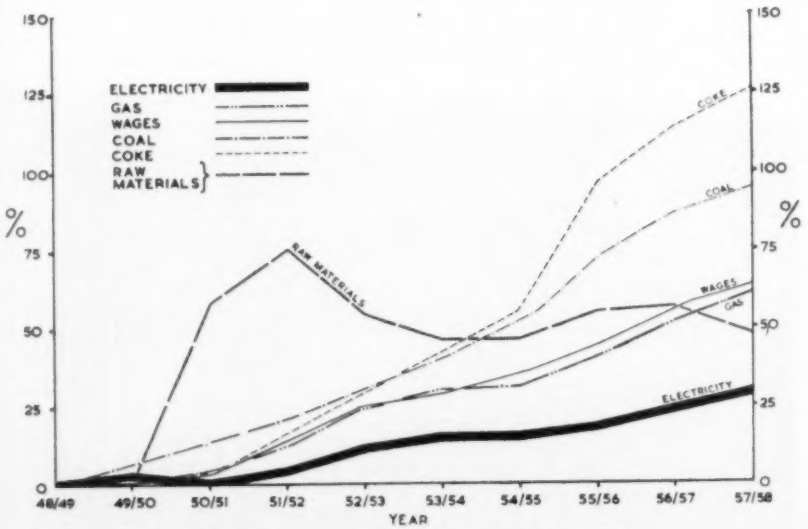
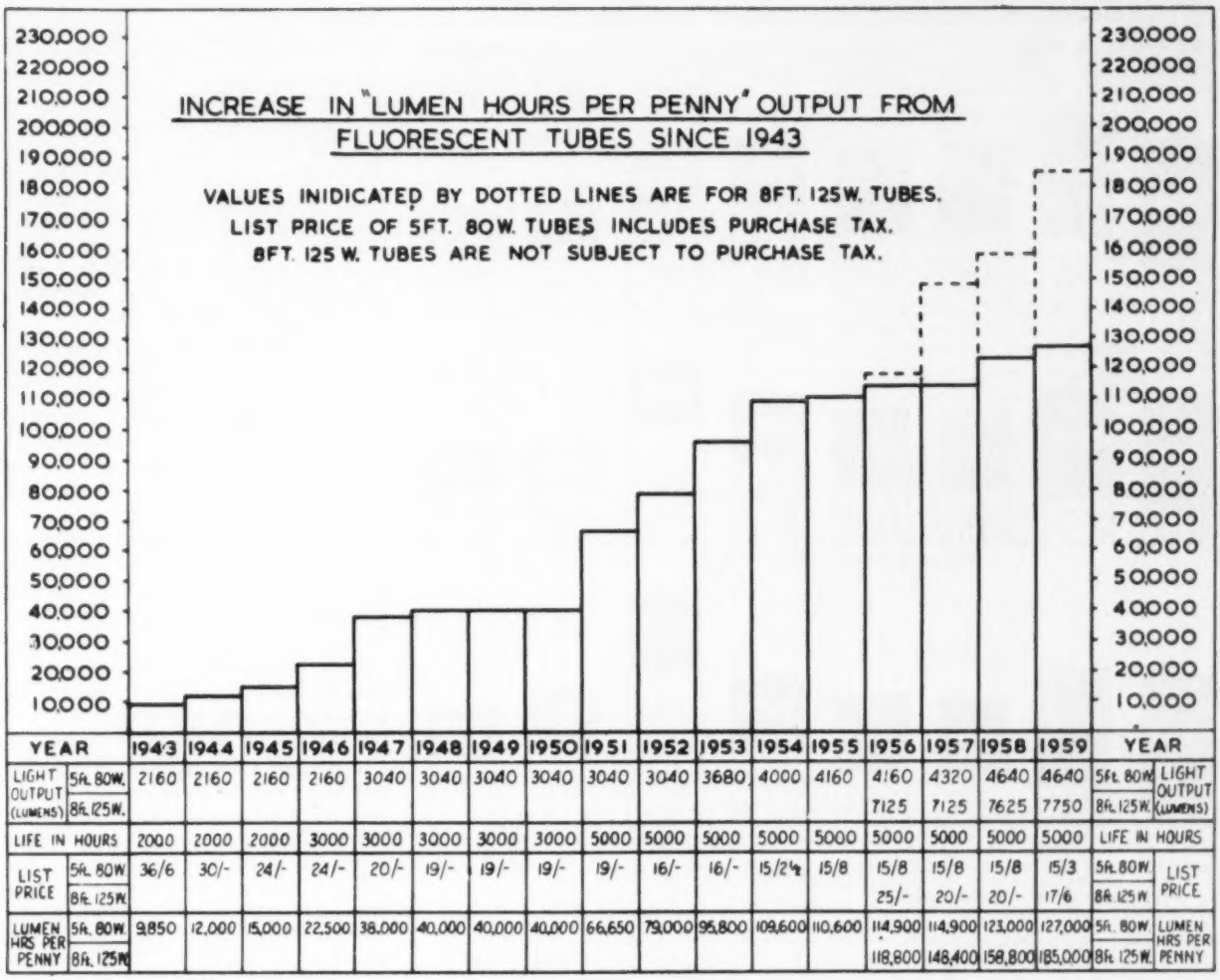


Fig.1, Increases in cost of factors of electricity production.



YEAR		1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	YEAR
LIGHT OUTPUT (LUMENS)	5ft. 80W.	2160	2160	2160	2160	3040	3040	3040	3040	3040	3040	3680	4000	4160	4160	4320	4640	4640	5ft. 80W.
	8ft. 125W.														7125	7125	7625	7750	8ft. 125W.
LIFE IN HOURS		2000	2000	2000	3000	3000	3000	3000	3000	5000	5000	5000	5000	5000	5000	5000	5000	5000	LIFE IN HOURS
LIST PRICE	5ft. 80W.	36/6	30/-	24/-	24/-	20/-	19/-	19/-	19/-	19/-	16/-	16/-	15/2½	15/8	15/8	15/8	15/8	15/3	5ft. 80W.
	8ft. 125W.														25/-	20/-	20/-	17/6	8ft. 125W.
LUMEN HRS PER PENNY	5ft. 80W.	9,850	12,000	15,000	22,500	38,000	40,000	40,000	40,000	66,650	79,000	95,800	109,600	110,600	114,900	114,900	123,000	127,000	5ft. 80W.
	8ft. 125W.														118,800	148,400	158,800	185,000	8ft. 125W.

Fig.2, (by Dr. H. H. Ballin).

a table produced by Dr. H. H. Ballin (see Fig.2) to show the progressive increase in light output and *decrease* in cost that has taken place since 1943. He mentioned the wide range of colours now available—"to suit every requirement of home and factory, office or shop, and even the milking parlour of the modern farm"; the guaranteed life of at least 5,000 hours; the light output per watt—some three or four times that of the tungsten lamp; and the fact that, while life-span and output have both doubled, the price has been halved.

"Progress in the lighting industry," said Mr. Irens, "has been matched by the electricity supply undertakings." While progress is less dramatic in this sector, it is true that, during the last 20 years, generator station output per 1 lb. of coal has risen by 16 per cent, and that, although wages went up by 63 per cent, coke by 126 per cent and coal by 92 per cent, electricity (in 1957/58) cost only 30 per cent more than it did in 1948/49 (see Fig.1).

Taking into account improvements in efficiency of electricity production and utilisation, as well as reductions in lamp prices, Mr. Irens claimed that "the cost of artificial light today is only about one-fortieth of what it was 30 years ago

Table 1
Lamp Efficiencies

Type of lamp	Output (lm/watt)	Running costs (lm.hrs/1d)
Carbon	4	350
Tantalum metal filament	9	750
Gas-filled tungsten	15-20	3,000
Colour-corrected mercury discharge	40	20,000
Fluorescent	60	30,000
Linear sodium	100	50,000

(see Table 1). However, full advantage cannot be taken from these improvements unless the most appropriate form of installation is chosen for each type of building and each set of circumstances. Thus, as can be seen from Fig.3 (based on information supplied by G. V. McNeill), mounting height alone can affect the choice of lamp, while this choice may be changed according to whether, in a particular factory, one, two or three shifts are worked.

Mr. Irens next pointed out what a very small percentage of total production costs is represented by electricity consumption for artificial lighting. Comparing weekly average wages (when artificial lighting is used) with lighting running costs in a variety of industries, he showed by means of a table that good lighting (with illumination levels ranging from 15 lm/ft² in a shoe factory to 50 lm/ft² in the assembly shop of an electronic equipment works) costs, on average, only 1.37 per cent of the wage bill. He claimed, moreover, that, using

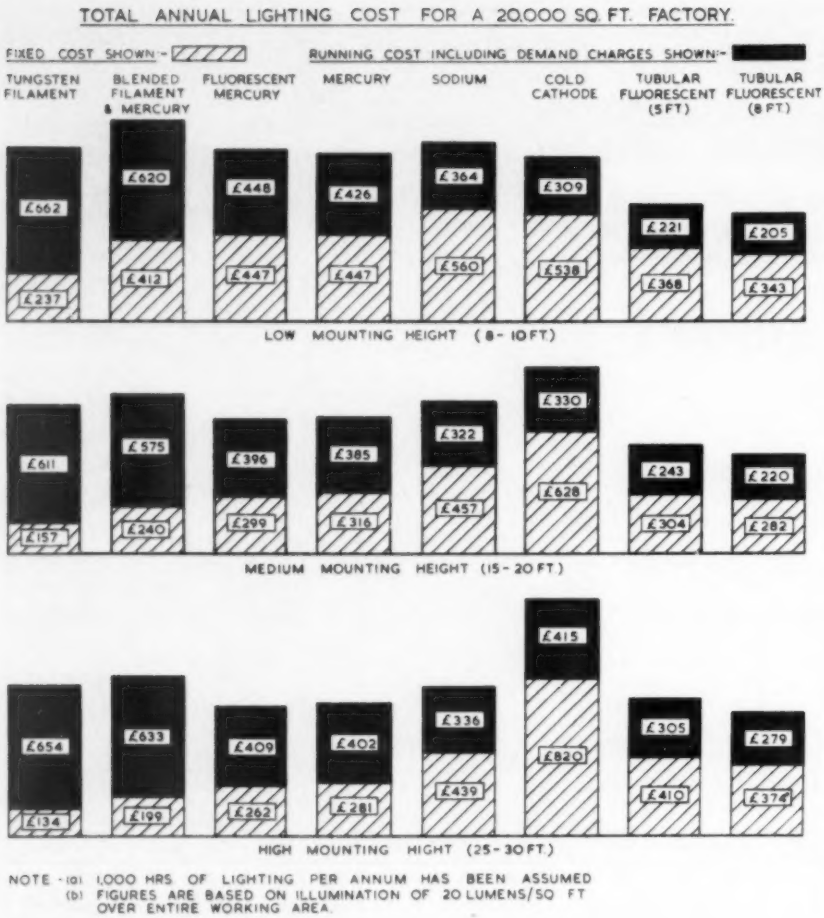


Fig.3 (data by G. V. McNeill).

fluorescent lamps, a 20,000 sq. ft. factory could be lit to a level of 20 lm/ft² on the working plane for as little as £2 10s. a year (or ½d. a working hour) per 100 sq. ft. of floor area, including all capital charges of fittings and installation, lamp replacements and current consumption. Assuming 100 sq. ft. as the space allowance for one worker earning £10 a week, Mr. Irens put it like this: ". . . the cost in time alone of a 10-minute morning and afternoon tea-break is over six times the total cost of providing a really good standard of artificial lighting.

To convince themselves of how little good lighting costs, commercial users should, said Mr. Irens, have their lighting circuits separately metered. While consumption could be calculated approximately, so long as the electricity units consumed by lighting were absorbed in the main electricity account, managements would frequently remain "without an economic incentive for investigating their return on lighting expenditure and seeking means of obtaining better value for money by wisely deploying lumens to raise production efficiency and improve working conditions."

On the relationship between lighting and eye-strain, Mr. Irens stated that "80 per cent of all actions are said to be visually controlled"; that "eye-strain and consequent fatigue, if allowed to persist, cannot fail to cause accidents and illness"; that good lighting "facilitates inspection and reduces spoilage . . . 'brings out' dirt, creating a clean and healthy environment which encourages recruitment (a valuable asset in times of full employment) . . . reduces the handicap imposed by lack of skill, thus making the employer less dependent on the experienced worker . . . and keeps up the working efficiency of the older operatives when their eyes begin inevitably to suffer the ravages of age."

After admitting that they should be taken "with a pinch of salt"—not because they were exaggerated but because they dealt with premises that might have been improved in several ways simultaneously—Mr. Irens then quoted a number of case histories of the effects of improved lighting:

1. A chain of 14 shops in a Northern territory had illumination levels increased by 10 lm/ft² and colour schemes changed; turnover increased by 20 per cent.

2. A 30-year-old installation in a Brighton drapery store was replaced by fluorescent fittings; turnover increased 19 per cent within six months.

3. A tile manufacturer experienced difficulties in the selection of coloured tiles for fireplaces. Local lighting using colour-blended fluorescent lamps to give 140 lm/ft² over the inspection benches led to an increase in rejects; this, in turn, led to investigation of the source of the trouble; kiln design and production processes were changed and variation in the product reduced.

4. A rise from 2 to 10 lm/ft² in a specialist foundry led to improved mould pouring and inspection so that the saving in rejects covered the cost of the

Table 2

	Original installation (tungsten)			New installation (mercury fluorescent)			Cost of conversion	Annual saving	Capital recovery period years	Level of illumination
	Loading kW	Annual running cost	Annual maint. and depreciation	Loading kW	Annual running cost	Annual maint. and depreciation				
A	550	£8,720	£1,851	155	£2,475	£851	£3,706	£7,245	0.51	Up to Standard
B	96	£2,840	*£378	57.6	£1,730	†£564	£2,330	£924	2.52	Increased from 3.5 lm/ft² to 11.5 lm/ft²
C	1,527	£29,249	£6,983	785	£13,674	£6,916	£26,901	£15,642	1.84	Maintained

* This figure excludes depreciation.
† This figure includes depreciation on additional capital equipment.

new installation within 12 months. (The shop steward was so impressed that he sent a full report, with photographs, to his TU headquarters.)

5. Until recently assumed to be a task that could only be carried out in daylight, so that work had to cease at dusk, plain paper 'overhauling' is now being done under artificial light (using special fittings for 80-watt colour-matching fluorescent lamps) some 10 per cent quicker than in daylight.

6. In a large steel-tube foundry improved lighting with mercury discharge lamps now facilitates the detection of hair-cracks in castings.

7. In a GPO sorting office a doubling of lighting level—from 3 to 6 lm/ft² gave a 20 per cent increase in output.

8. A rise from 3 to 9 lm/ft² in a wire-drawing shop raised output by 17 per cent.

9. An increase from 5 to 20 lm/ft² in a works producing roller bearings led to a 12½ per cent rise in output.

Mr. Irens mentioned also the use of artificial lighting in horticulture and in poultry houses, and gave examples of how industrial lighting can often be improved while the cost is *reduced*. In Table 2 figures are given for three buildings where replacing tungsten lamps by mercury discharge lamps so reduced current consumption and lamp replacement costs that the capital costs were recovered in, respectively, 6 months, 2½ years and 20 months. (In the first and third cases—the Britannia hangars of the Bristol Aircraft Co. and the premises of a motor car manufacturer—lighting levels were maintained, while in the second case—a steel pressings factory—the level was raised by over 200 per cent.)

As in many things, it is necessary to be on guard against false economies, and Mr. Irens quoted near the end of his lecture the example of a large factory where lamp replacement costs were reduced from £1,250 to £350 a year "by replacing all lamps in groups after a predetermined number of burning hours instead of replacing lamps individually as and when they failed." The re-lamping is now carried out at weekends, when the maintenance men receive double pay, instead of during normal working hours when lamp replacement would necessitate the interruption of productive work.

Finally, Mr. Irens said that, while preparing his paper, he had found that very little use had so far been made of 'case histories' as a means of bringing facts about lighting and productivity to the notice of industrial and commercial users. He had, therefore, drawn up the questionnaire reproduced in Figs.4 and 5, which he said should be completed as "a combined operation by the installation engineer, the electricity board and the user." Summarising the information provided and, in a suitable form, publishing it to all interested parties might, suggested Mr. Irens, be a task for the British Lighting Council.

Name and address of firm .....

Type of business .. ..

.....

Name and address of lighting engineers .. ..

.....

Name and address of observer .. ..

.....

Test Data

Period of test .. ..

Original factory output .. ..

Final factory output .. ..

% change in output .. ..

Original rejects .. ..

Final rejects .. ..

% change in rejects .. ..

Remarks

Reaction of staff, etc.

(This space to be at least half a page.)

Fig.4, Front of Questionnaire.

	Original Installation	*Final Installation*
Floor area	.....	.....
Number of workers ..	.....	.....
Capital cost of installation ..	.....	.....
Number of lighting fittings ..	.....	.....
Type of lighting fittings ..	.....	.....
Amount of local lighting ..	.....	.....
General level of illumination	.....	.....
Local level of illumination ..	.....	.....
Total wattage of installation	.....	.....
Units of electricity consumed	.....	.....
(*a*) from.....to.....	(*a*)	
(*b*) from.....to.....		(*b*) .....
Man hours for maintenance and cleaning fittings ..	.....	.....
Colour of ceiling	.....	.....
Colour of walls	.....	.....
Colour of floor	.....	.....
Colour of overhead services	.....	.....
Colour of machinery ..	.....	.....
Colour of benches	.....	.....
Observer's Reaction		
Feeling of glare	.....	.....
	.....	.....
General impression	.....	.....
	.....	.....
	.....	.....
	.....	.....

Fig.5, Reverse of Questionnaire.

LIGHTING ABSTRACTS

OPTICS AND PHOTOMETRY

535.31

799. IES Guide to design of light control. Part I—Physical principles.

Illum. Engng, **54**, 722-727 (*Nov.*, 1959).

Prepared by the Committee on Light Control and Equipment Design of the American IES, this first part of a Guide to the principles and practices of light control deals primarily with physical and geometrical optics, the simpler principles being explained by the former approach to optics and the more complex principles by the latter approach. A second part of the Guide will be concerned with the design of optical elements.

P. P.

535.24

800. A new luminance—and luxmeter.

S. ANDERSSON, *Ljuskultur*, 159-164 (*July-Sept.*, 1959). *In Danish.*

A small portable meter built into a 35-mm camera body, the light-sensitive element being a CdS phototransistor. Details of spectral sensitivity, temperature coefficient, and cosine response are given, together with constructional details. Luminances above 3 cd/m^2 can be measured.

R. G. H.

LAMPS AND FITTINGS

621.329

801. Why styling?

S. BERNADOTTE, *Ljuskultur*, **31**, 120 (*July-Sept.*, 1959). *In Swedish.*

Everything manufactured has to be 'styled' nowadays. The reason is the public demand for good design, but the designer cannot work miracles on an inherently poor product. Teamwork between technologist, designer, and salesman are necessary. The application of styling principles to lighting fittings is discussed.

R. G. H.

621.32

802. Use of gaseous radioactive isotopes in lighting technology.

G. SILJEHOLM, *Ljuskultur*, **31**, 189-191 (*Oct.-Dec.*, 1959). *In Swedish.*

Gaseous radioactive isotopes which emit β-rays can be used to stabilise the magnitude of the striking voltage in starting sintels of the glow-discharge type. Tritium and Krypton 85 have a suitable half-life (12.5 and 10.6 years respectively). These isotopes can also be used as the filling for 'permanent' light sources, but so far experimental lamps of this kind have very small light outputs. The source consists of a tube coated with a phosphor whose thickness must be graded to the voltage equivalent to the acceleration of the electrons emitted by the isotope.

R. G. H.

621.32

803. Early history of the electric lamp.

W. GURSKI, *Lichttechnik*, **11**, 643-649 (*Dec.*, 1959). *In German.*

Traces the history of electric light sources from the publication, in 1780, of a description of a so-called electric lamp depending on the ignition of hydrogen by a spark discharge. The first practical lamp was the arc (1812), especially in the form known as the Jablochkoff candle (1876). A mercury discharge lamp was invented in 1860. The filament lamp, originated by Goebel in 1854, was made practical by Edison. (Rival claims to priority are mentioned but not discussed.) Some fittings of 1881-5 used with filament lamps are illustrated. The author describes developments in photometry and standards. A journal devoted to electric lighting was first published in 1879. There is a useful, but not exhaustive, list of books.

J. W. T. W.

621.327.534.15

804. Measurements on capacitors used as auxiliaries in low-voltage fluorescent lamp circuits.

C. H. STURM, *Lichttechnik*, **11**, 594-596 (*Nov.*, 1959). *In German.*

Tests for capacitors to be used as auxiliaries in fluorescent lamp circuits have been specified, both nationally and internationally, and the author describes such tests carried out on a number of commercial capacitors and gives the results obtained. In particular he gives, for the 4 ft. 40-watt lamp, the relationship between the capacity and the watt loss in the choke at constant light output. The number of starts to failure, for a variety of lamps, some with and some without starters, has been determined. A frequency distribution curve is given for the watt losses in commercial ballasts used with the 40-watt lamp.

J. W. T. W.

535.81

805. Proposed method of measuring the hiding power of light shielding materials.

W. O. BENJAMIN and C. W. CLARKSON, *Illum. Engng*, **54**, 706-711 (*Nov.*, 1959).

Shielding materials for light sources may be characterised as louvering, refracting or diffusing, and their optical performances can be specified in a number of ways. Reflected images of shielded light sources can cause both discomfort and disability glare, the brightness contrasts in those portions of the shielding which are seen by reflection being of most concern. These contrasts are dependent on the ability of the shielding material to obscure the light source. Measurements have been made of the brightness gradients (candelas/sq. in./in.) of a number of shielding materials and these have been used to derive Obscuring Power Factors (OPFs) which give a measure of the susceptibility of the material to the production of reflected glare.

P. P.

621.329

806. Performance characteristics of combination air-diffusing troffers.

M. L. QUIN and W. W. KENNEDY, *Illum. Engng*, **54**, 695-700 (*Nov.*, 1959).

The demand for increased flexibility in the provision of services to building interiors had led to the concept that the lighting, heating and acoustical requirements can be jointly met by specially designed modular ceiling units. In particular, attention has been given to the development of flush-mounted luminaires which also incorporate air-conditioning inlet and extract facilities. Two types of air diffusion are considered, for which tabulated performance data are given. The pressure drop necessary to develop the requisite air flow through the luminaire can generate noise, and this is considered in relation to noise criterion curves. The effect of air temperature and velocity on the relative light outputs of the luminaires and on the ballast operating temperature is also considered in respect of luminaires incorporating each of the two types of air diffusion.

P. P.

621.327.43

807. Measuring F-lamp characteristics for the outdoor environment.

P. R. HERRICK and R. E. WENNER, *Illum. Engng*, **54**, 686-691 (*Nov.*, 1959).

In order that the outdoor performance characteristics of fluorescent luminaires can be assessed, photometric data obtained in still-air conditions on such luminaires need to be supplemented with information on the effect of ambient temperature and wind speed. An environmental test chamber has been used to obtain these data, the environment being variable between $-40°$ and $+100°$F, 10 and 90 per cent relative humidity and 3 and 25 mph wind speed, using automatic programming and recording. A mean curve relating percentage of peak light output and °F above or below the temperature corresponding to peak light output has been derived which

is applicable to most luminaires and can be used to predict detailed photometric performances from a few simple observations.

P. P.

LIGHTING

628.971

808. A new method for studying effects of direct sunlight on building interiors and subsequent skylight studies.
B. H. EVANS and M. NOWAK, *Illum. Engng*, **54**, 715-721 (*Nov.*, 1959).

Measurements under an artificial sky at the Texas Engineering Experiment Station of the amount of sky-light in model rooms are now being supplemented with measurements of the amount of direct and reflected sunlight in such rooms. To do this, the natural sun is being simulated in the laboratory by a 5,000-watt incandescent spot light, the model being placed on an adjustable table to reproduce the desired solar angles. Satisfactory cross-checks have been made against the same models, and against a similar full-scale room, when exposed to the natural sun and sky. The light transmission characteristics of skylights, including the problem of sun glare, have also been given some consideration.

P. P.

809. Window type and size. 628.92
C. H. KREUGER, *Byggmästaren*, **38**, 174-176 (No. 8, 1959). *In Swedish.*

A concise summary of the Swedish Royal Building Commission's report on windows. Among the many detailed conclusions is that double pane windows of painted deal are easiest to produce and repair. Triple-glass windows are not economical except in the colder areas. Windows to allow direct sun to penetrate are of great importance in work and dwelling rooms but not necessary in secondary spaces, e.g., stairways.

R. G. H.

810. The heat balance of a window. 628.92
G. PLEIJEL, *Byggmästaren*, **38**, 14-19 (No. 1, 1959). *In Swedish.*

Heat lost through a window due to poor insulation can be considerable in winter, but a window not only lets in light but heat as well, and what is often forgotten is that the sky radiates a large amount of heat, in addition to that received direct from the sun. The methods for calculating the amount of heat lost and gained through the window are developed, and heat balances calculated for all periods of the year. Double and triple pane windows, with or without additional protection devices, are considered. The effect of this economic balance in relation to the use of glass for natural lighting is discussed.

R. G. H.

612.843.367

811. Practical application of direct discomfort glare research in the new Australian artificial lighting code.
J. C. LOWSON, *Trans. Illum. Eng. Soc. (London)*, **24**, 160-184 (No. 4, 1959).

When recommended luminance limits for diffusing luminaires and bare fluorescent lamps came to be written into the new (1957) artificial lighting code of the Standards Association of Australia, it was decided to adopt the Harrison-Meaker glare tables but to 'turn them inside out'. Before doing this, though, a check was made on the validity of the Harrison-Meaker tabular method by what has now become known as the 'Sydney glare appraisal tests'. Various simplications were introduced including restricting the range of luminance limits to only eight values (ranging between $\frac{1}{2}$ and 8 cd/in^2) and omitting the correction for illumination level.

P. P.

812. A discussion on home lighting. 628.972
S. MOLLERYD, *Ljuskultur*, **31**, 215-218 (No. 4, 1960). *In Swedish.*

In connection with an exhibition of lighting in Gothenburg, a question-and-answer discussion between a housewife, an architect, several lighting experts and an ophthalmologist was arranged to illustrate in everyday terms the principles of good lighting. The ophthalmologist pointed out that many visual tasks in our days were more difficult and needed more light, e.g., the print in the telephone directories was now smaller than before.

R. G. H.

628.972

813. An old established lighting firm in a new building.
C. B. HOLMBERG, *Ljuskultur*, **31**, 76-81 (No. 2, 1959). *In Swedish.*

A description with illustrations of the workrooms, offices and showrooms of the firm of Bohlmark. The offices employ fluorescent lighting placed above the windows to maintain the directional character of the lighting.

R. G. H.

814. An experiment with school lighting in Finland. 628.972
E. PAIVARINNE, *Ljuskultur*, **31**, 127-129 (No. 3, 1959). *In Swedish.*

Five different classroom lighting systems each to give 30 lm/ft^2 were installed in similar classrooms, and measurements made. The installations were (a) symmetrical ceiling inset fluorescent units, (b) asymmetric mirror reflector ceiling inset fluorescent units, (c) ceiling lighting behind opal plastic, (d) general service incandescent lamps in reflector fittings and (e) reflector lamps in fittings with aluminium screens. The installations were measured for luminous efficiency and contrast and studied for direct and reflected glare, and for the brightness distribution. The incandescent installations came out badly on account of glare; to minimise this, indirect lighting of lower overall efficiency would be necessary.

R. G. H.

815. Discussion on the lighting of football arenas. 628.971
P. SANDGREN, *Ljuskultur*, **31**, 136-9 (No. 3, 1959). *In Swedish.*

The various methods of lighting football fields are discussed by a lighting engineer, a goalkeeper, and a stadium architect. The subjective effect of play being much quicker under artificial light is attributed to the need for a longer 'retinal exposure time' under low illuminations in order to see the ball.

R. G. H.

816. Football under electric lighting in Rosunda. 628.971
G. HASSEL, *Ljuskultur*, **31**, 135-136 (No. 3, 1959). *In Swedish.*

The new Rosunda stadium in Stockholm has an installation consisting of batteries of projectors mounted on four masts 42.5 metres high, each battery consisting of 17 x 1,500-watt mercury vapour lamps and 14 x 1,500-watt plus 2 x 2,000-watt incandescent lamps in mirror projectors, giving an average illumination of over 30 lumens/sq. ft.

R. G. H.

628.98 : 612.843.367

817. Development of a physiological glare index characteristic of a lighting fitting.
W. DITTRICH, *Lichttechnik*, **12**, 25-27 (*Jan.*, 1960). *In German.*

The author applies the Holladay formula for disability glare to a row of sources, either indoors or on a street, and derives a relationship between (a) the average glare experienced in travelling along one unit of the installation and (b) the luminous intensity distribution from a source. He assumes uniform height and spacing. On this basis he derives a glare figure characteristic of the source distribution. The method is mainly applicable to distributions with a pronounced maximum. With typical distributions for a dispersive fitting and a concentrating fitting the glare figures found are 3.55 and 0.145 respectively.

J. W. T. W.

HOME LIGHTING

Prize-winning Scheme from United States

DOMESTIC lighting installations comprising something more than an adequacy of pendants, wall lights, table lamps and standards are few and far between in this country. It is, therefore, to America that we must turn for an example of fully integrated domestic lighting designed with the same care and attention that is more frequently devoted to commercial installations, though it is not suggested for a moment that such an approach is by any means typical, even in the United States.

The lighting scheme for this Portland, Oregon, home was designed by Al Natalie of the Pacific Power and Light Co. With it he won first prize in the Pacific Northwest Region contest of the American IES "My Most Interesting Lighting Job" (MMILJ) competition. The house was promoted by a local builder by the name of Way Lee. It is unconventionally planned around the activities of the modern American family, having a floor area, on one floor, of 2,010 sq. ft., plus a 1,700 sq. ft. basement. The combined living-dining room has two wall-length pelmets concealing eight 4ft. 40-watt, rapid-start, de-luxe warm white fluorescent lamps. Sparkle can be provided, when guests are being entertained, by two ceiling mounted eyeball spotlights housing 150-watt lamps that highlight the fireplace surround of white Georgia marble, and by two pin-point spotlights wall-mounted above the settee.

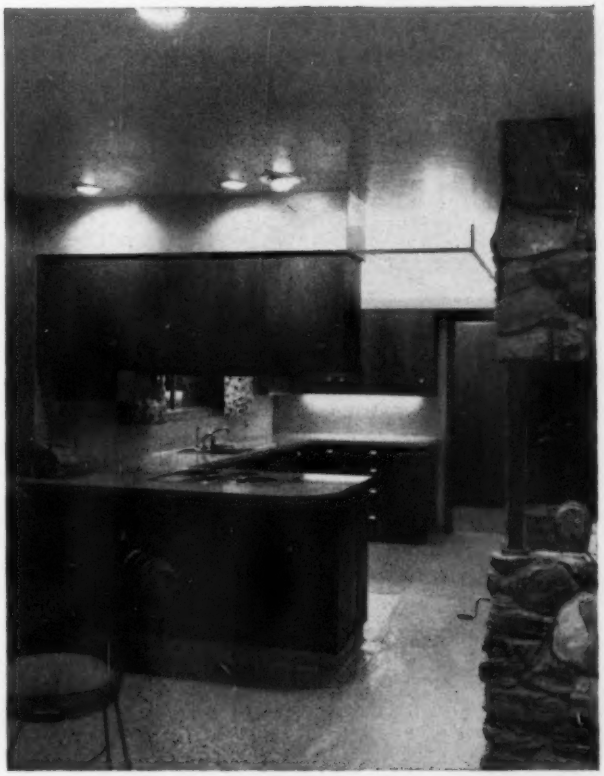
These spotlights, together with two 40-watt tubular tungsten lamps concealed by the pelmet, give adequate light for reading, while decorative lighting is provided by one outsize table lamp and by a pierced bronze pendant fitting (imported from India) also housing a 40-watt tubular tungsten lamp. In addition, there is a rise-and-fall pendant over the dining table, housing three 60-watt lamps on a dimmer circuit, making the total lighting load for this living-room something over 1,000 watts.

Main lighting for bedrooms again comes from 40-watt, rapid-start, fluorescent lamps concealed by wall-length pelmets, these lamps being on dimmer circuits. The pelmet above the bed also conceals four 40-watt tubular tungsten

lamps, separately switched for reading in bed, and there is a 150-watt tungsten fitting recessed into the ceiling to light the dressing table. The large table lamps are, again, more decorative than functional.

General lighting for the kitchen is from a "rug-size" luminous panel suspended from the ceiling; 6ft. square, it is lit by twelve 75-watt tungsten lamps. Spotlights in the ceiling light the sink; a 60-watt tubular tungsten lamp lights the control panel of the cooker; while four 40-watt, rapid-start fluorescent lamps fixed to the undersides of high-level cupboards light the working tops below them.

In the bathrooms there are luminous coves (lit by a pair of 4ft. 40-watt, instant-start fluorescent lamps) over the wash basin and mirror, while the shower cubicle has a 60-watt tungsten fitting recessed into its soffit. The house is surrounded by lighted patios and gardens. Enclosed by a high fence this outdoor living-area is lit by "mushroom" fittings, while the heated swimming pool has underwater lighting.



Opposite page: General lighting for the living room (with dining area in foreground) is from instant-start fluorescent lamps behind long wall-mounted pelmets. Spotlights are directed on to the fireplace and settee. Above, a similar arrangement lights the principal bedroom, with extra, tungsten, lamps behind the pelmet over the bed, separately switched for reading. Right, kitchen, seen from breakfast recess, with lamps concealed under the cupboards giving direct lighting on to the working tops.

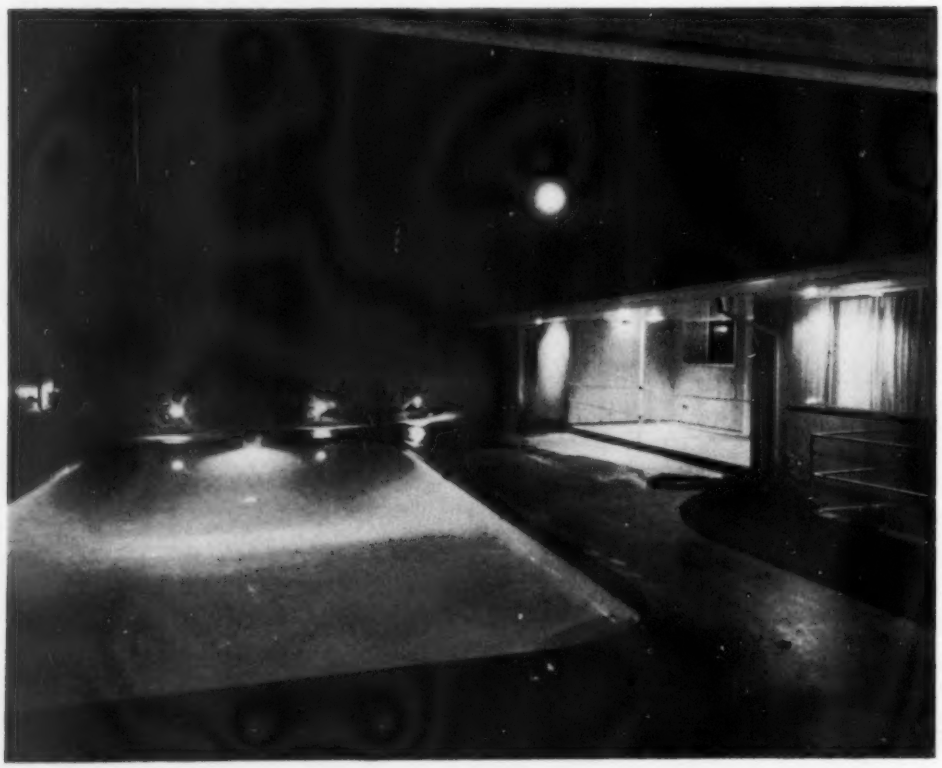
Right, interior of the kitchen, showing 'rug-size' luminous ceiling panel lit by twelve 75-watt tungsten lamps. Centre, bathroom, with cove lighting above wash basin and mirror. Bottom, exterior lighting includes mushroom fittings in the shrubberies, spotlights over the porch and underwater fittings in the heated swimming pool.

To sum up—the lighting of this house, while it does not embody any revolutionary ideas, makes good use of several forms of lamp—tungsten, tungsten tubular, tungsten spots and fluorescent—and a variety of techniques. Thus, there are the pelmets concealing fluorescent lamps; the area of luminous ceiling in the kitchen; and the spotlights directing beams of light on to the living-room fireplace.

Separate switching of these different sources, together with the dimming of the rise-and-fall pendant over the dining table, makes it possible for the occupants to change the atmosphere of the main rooms according to the use to which they are being put, the number of people present, the time of day, season of the year, etc. Yet there are no excessively expensive fittings and, when the high cost of fittings frequently found in indifferently lit homes is taken into account, the total cost of the installation cannot be considered high.

Finally, it is noteworthy that, apart from the decorative effects of the patterns of light resulting from the scheme, the principal light sources themselves are not items of decorative interest. The table lamps, on the other hand, with their antique bases and outsize shades, are frankly decorative. While they add to the general level of illumination, their purpose is almost entirely to enhance the interior decor.

(Acknowledgement is made to the IES, New York, for the information and photographs included in this article.)



National Illumination Committee of Great Britain*

Report for the year 1959

By far the most important event in the period under review was the fourteenth session of the International Commission on Illumination which was held in Brussels from June 15th to 24th. The session was held under the presidency of Dr. J. W. T. Walsh and was the culminating point of his four-year term of office. In all, 26 countries were represented and there were over 500 delegates present, of whom about 85 were from this country. The Leader of the British delegation was Mr. H. C. Weston and the Deputy Leader was Mr. W. R. Stevens.

The subjects on the programme of the Commission were about equally divided into two groups, viz., those dealt with by working committees and those using the older method of reporting by secretariat. Of the latter, only one—lighting for photography, cinema and television production and theatre stages—was the responsibility of this country and in this case the report was presented by Mr. Stevens. In the other group, however, the chairmen of four of the working committees were from this country and each was in charge of the corresponding technical session; they were: Mr. Weston (visual performance), Mr. J. M. Waldram (street lighting), Mr. E. S. Calvert (aviation ground lighting) and Mr. B. Boorman (colours of light signals). At the meeting at which the last named subject was dealt with, Mr. Boorman formally presented a report which had been printed in the three languages in Great Britain, through the agency of the Committee, as an official publication of the CIE.

Technical meetings on all subjects were held and for each a leader and a reporter for the British delegation had been appointed from among those attending from this country.

Towards the end of the session, two days were devoted to the presentation of papers. Of the 23 papers read, the following three were from this country: "Hospital lighting," by Mr. J. Musgrove and Dr. W. J. W. Ferguson, "Adaptation and scales of brightness," by Dr. R. G. Hopkinson, and "Natural lighting prediction and the design of window systems for tropical climates," by Mr. P. Petherbridge.

At the conclusion of the session, it was announced that Mr. Ivar Folcker, of Sweden, would be the new President, the Vice-Presidents being Dr. Brainerd (USA), Prof. Deaglio (Italy), Dr. Fink (Austria) and Prof. Schneider (Germany). The other officers, i.e., Mr. W. W. E. von Hemert, of the Netherlands, and Prof. Y. Le Grand, of France, as Treasurer and Secretary respectively, will continue in their former positions. It was agreed to meet next in Austria in 1963.

It is gratifying to note that Mr. J. M. Waldram is a member of the CIE Papers Committee, Prof. W. D. Wright of the CIE Scope Committee and Mr. J. G. Holmes of the CIE Finance Committee.

One result of the use of working committees has been to reduce appreciably the number of formal recommendations arising at a CIE session. No objection has been raised to any passed in Brussels.

In drawing up the programme for the next period, the CIE Scope Committee introduced the subjects of the characteristics of materials used in lighting, and sound and light; the subject of floodlighting and advertising signs has been brought back, whilst that of lighting legislation has been discontinued. The designation "Working Committee" was changed to "Committee of Experts" or E-Committee. The following gives the list in detail.

CIE REF.	SUBJECT	SECRETARIAT COUNTRY
E1.1	Definitions, Vocabulary	France
S1.2	Measurement of light	Japan
E1.3.1	Colorimetry	USA
E1.3.2	Colour-rendering	Germany
E1.3.3	Colours of light signals	Great Britain
E1.4.1.	Photopic and scotopic vision	USSR
E1.4.2	Visual performance	Netherlands
S2.1.1	Sources of visible radiation	Sweden
E2.1.2	Sources of u.v. and i.r. radiation and measurement	Germany
S2.2	Characteristics of materials used in lighting	Austria
E3.1.1.1	Predetermination of illumination and luminance	France
E3.1.1.2	Causes of discomfort in lighting	USA
E3.1.1.3	Pleasantness in lighting	Netherlands
S3.1.2	Home lighting	Denmark
	School and office lighting	Finland
	Industrial lighting	Iceland
	Lighting of public buildings	Norway
	Hospital lighting	Sweden
	Lighting for selling	
	Lighting for transport (other than automobile and air)	
	Lighting for indoor and outdoor sports	
	Sound and light	
	Floodlighting and advertising signs	
S3.1.5	Mine lighting	Poland
E3.1.9.2	Lighting for photography, cinema, television production and theatre stages	Great Britain
E3.2	Daylight	Australia
E3.3.1	Street Lighting	Belgium
E3.3.2.1	Aviation ground lighting	Great Britain
E3.3.3	Airborne lighting and signals	USA
E3.3.5	Automobile headlights and signal lights	France
E3.3.7	Signal lights	Germany
E4.1.1	Lighting education in schools	Switzerland

Since the CIE Session, the NIC/CIE Panel has considered the participation of the Committee in these studies and nominations of experts and chairmen of NIC sub-committees will be submitted to the Annual General Meeting of the Committee to be held in January, 1960.

The Committee of Administration has given consideration to the Rules which were last revised in 1949 and a number of changes have been suggested; the most far-reaching is that the main Committee shall be finally responsible for the ap-

* The NIC is affiliated to the International Commission on Illumination. This report was approved at the annual general meeting of the Committee held on Thursday, January 28th, 1960.

proval of any changes and not the Committee of Administration.

It has been learnt with regret that the Institution of Gas Engineers, one of the founder bodies of the Committee in 1913, has decided to cease being a sponsoring organisation; it will, however, continue active support of the Committee as a co-operating organisation. One result of this change is that Mr. F. C. Smith has now ceased to be a member of the Committee. He has been an active member of the Committee since 1935, and during that period was a Vice-Chairman for 13 years and one of the representatives on the CIE Executive Committee for 9 years; he was also the Deputy Leader at the CIE Sessions in 1951 and 1955. The Committee wishes to pay a warm tribute to him for his many services.

The British Electrical and Allied Manufacturers' Association has now withdrawn from a membership of the Committee which has lasted since 1927, but the War Office is now a co-operating organisation. As a result of the renaming of some of the Ministries and changes in their responsibilities, Mr. E. S. Calvert and Mr. E. G. Cooper (from the former Ministry of Supply) and Mr. N. F. Hildyard (of the Ministry of Transport) now represent the Ministry of Aviation.

There have been the following changes of membership during the year. Mr. C. C. Smith has replaced Mr. Lennox as a representative of the Illuminating Engineering Society, the latter being also a representative of the Electricity Council. The Admiralty is now represented by Capt. G. R. B. Pattison in succession to Mr. H. A. L. Dawson, whilst Mr. J. B. Harris of the Ministry of Works has taken the place of Mr. W. E. Rawson-Bottom, who until retirement had been the Ministry's representative for the last ten years; for most of this time Mr. Rawson-Bottom has been the chairman of the sub-committee on the lighting of public buildings and has been particularly active at CIE Sessions; the Committee wishes to place on record its appreciation of his services.

S. ENGLISH, *Chairman.*
L. H. MCDERMOTT, *Secretary.*

Constitution of Committee, December 31st, 1959.

Officers

Chairman: DR. S. ENGLISH.
Vice-Chairmen: W. R. STEVENS, H. C. WESTON.
Hon. Treasurer: E. B. SAWYER, British Lighting Council, Brettenham House, Lancaster Place, London, W.C.2.
Hon. Secretary: L. H. MCDERMOTT, National Physical Laboratory, Teddington, Middlesex.

Nominated by the Sponsoring Organisations

Illuminating Engineering Society: G. F. COLE, J. G. HOLMES, L. H. MCDERMOTT, C. C. SMITH, J. M. WALDRAM.
Institution of Electrical Engineers: C. W. M. PHILLIPS, H. R. RUFF, W. R. STEVENS, DR. J. W. T. WALSH, G. T. WINCH.
Institution of Gas Engineers: J. B. CARNE, A. G. HIGGINS, F. C. SMITH, D. M. THOMPSON, W. H. WELCH.

Nominated by the Co-operating Organisations

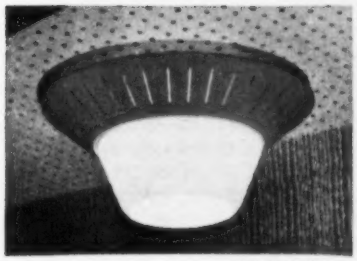
Admiralty: Capt. G. R. B. PATTISON.
Air Ministry: H. F. INNOCENT.
Association of Public Lighting Engineers: N. BOYDELL, H. CARPENTER.
British Electrical and Allied Manufacturers' Association: J. M. H. STUBBS.
British Electrical Development Association: J. I. BERNARD.
British Lighting Council: A. G. PENNY, E. B. SAWYER.
British Plastics Federation: DR. W. E. HARPER.
British Standards Institution: J. F. STANLEY.
British Transport Commission: A. H. COLE (*British Railways*). H. E. STYLES (*London Transport Executive*).
Building Research Station: W. ALLEN, DR. R. G. HOPKINSON.
Electricity Council: E. C. LENNOX, M. D. STONEHOUSE.
Electric Lamp Industry Council: W. J. JONES DR. J. W. STRANGE.
Electric Light Fittings Association: J. H. STUDHOLM, D. L. TABRAHAM.
Electrical Contractors' Association: A. H. OLSON.
Gas Council: J. B. CARNE, F. W. SANSOM.
Glass Manufacturers' Federation: D. G. OSBORNE.
Institution of Municipal Engineers: C. HARPER.
Medical Research Council: DR. W. J. W. FERGUSON, H. C. WESTON.
Ministry of Aviation: E. S. CALVERT, E. G. COOPER, N. F. HILDYARD.
Ministry of Education: G. W. MILBURN, A. P. POTT.
Ministry of Health: D. A. HUGHES.
Ministry of Labour: M. A. MCTAGGART.
Ministry of Power: J. COWAN, H. C. LISTER.
Ministry of Transport: DR. H. F. GILLBE.
Ministry of Works: J. B. HARRIS.
National Coal Board: R. BUFFRY, P. N. WYKE.
National Physical Laboratory: DR. W. S. STILES.
Nuffield Foundation: J. MUSGROVE.
Post Office: R. S. PHILLIPS.
Road Research Laboratory: G. GRIME.
Society of Dyers and Colourists: K. MCLAREN.
Society of Glass Technology: DR. S. ENGLISH.
War Office: T. ROBERTS.

Representatives of Great Britain on the Executive Committee of the International Commission on Illumination: A. G. HIGGINS, H. C. WESTON.

RHEA

PROCYON

HESTIA



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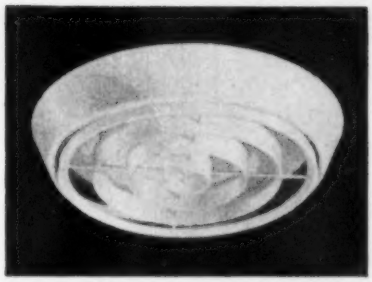

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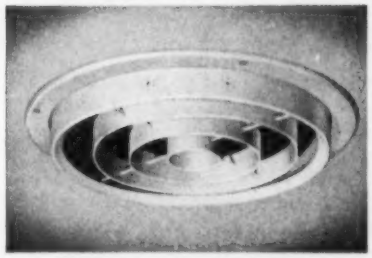

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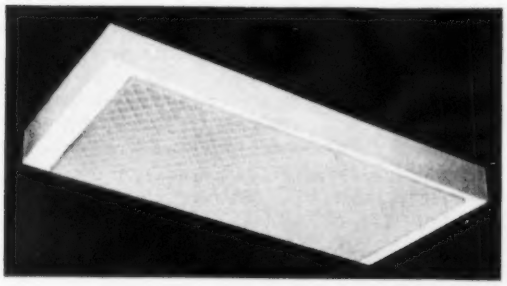

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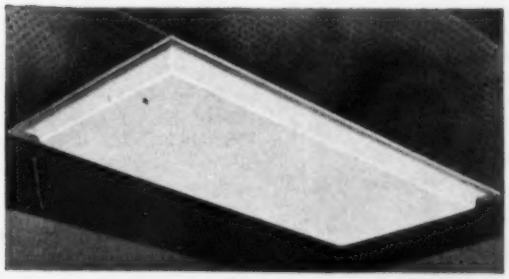

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AP 113

MISCELLANY

Situations

Vacant

ASSISTANT EDITOR required for *Light and Lighting*. Editorial experience essential, knowledge of production and advertisement procedure desirable. Write in confidence to the Editor giving age and full details of present and previous employments including type of work carried out, degree of personal responsibility and salaries. Examples of work may be submitted.

City of Birmingham Public Works Department, Mechanical and Public Lighting Section. Vacancy for ELECTRICAL ENGINEER, special grade £785/£1,070 per annum. Applicants should be Associate Members of the Institution of Electrical Engineers or hold the Higher National Certificate. Candidates should have experience of lighting engineering with particular reference to public lighting. The post is permanent, superannuable and subject to a medical examination. Applications stating qualifications, age and experience and naming two referees should be received by March 12th, 1960. Canvassing disqualifies. Herbert J. Manzoni, City Engineer and Surveyor, Civic Centre, Birmingham, 1.

Philips Electrical Ltd. have the following lighting vacancies located in the Midlands. LAMP APPLICATIONS ENGINEER—at least two years in a lamp factory is required, with a wide general knowledge of all types of lamps with particular emphasis on discharge lamps, and a qualification at least of H.N.C. standard. Ambition and potential to develop a technical selling career is essential. Age 23/35. LIGHTING ENGINEER—a good illuminating engineering training is necessary (Dip. MIES preferred) with a thorough knowledge of lamps and lighting equipment and circuits. Ability to deal with customers at all levels and discuss lighting problems is essential. Age 25/35. These are pensionable posts with progressive conditions of employment. A car will be provided. Interviews will be arranged in Birmingham, but applications should in the first instance be sent to the Employment Officer, Century House, Shaftesbury Avenue, London, W.C.2, quoting ref. 350.

DRAUGHTSMEN (one senior and two junior) required for Design Department of large old-established lighting fittings manufacturers situated North London area. 5-day week, canteen and social facilities, contributory pension scheme, etc. Write, stating age, experience and salary required to Box No. 704.

Lighting Fittings Design. Versatile DESIGNER/DRAUGHTSMAN with practical knowledge of manufacturing technique required for drawing office of old-established company in Central London. Diverse range of industrial commercial and specialised equipment. Contributory pension scheme. Box No. 705.

Correspondence

Education in illuminating engineering

Sir,—Mr. Hewitt, in his excellent "Random Review of 1959," has given us an all too accurate appraisal of the attitude of the industry towards technical background and relevant qualifications.

In May of last year I took a "First" in the City and Guilds Finals in Illuminating Engineering at the only college in London at which a course is available. Of this small class only a minority were directly concerned with lighting equipment and application, though all were taking the course voluntarily with the hope only of increasing or widening their sum of knowledge. The class was not filled to capacity.

I suggest, therefore, that Mr. Hewitt could well think again before casting at least part of the blame for the dearth of serious students of illuminating engineering on educational facilities, for rather is it the reverse. The industry neither encourages nor rewards such diligence.

Even worse it seems unconvinced of the need for the right technical background and qualifications in the people who both sell and design. Instead, the beards of commercial directors can be seen to waggle as they monotonously chant that vital word "experience." Let's face up to the truth. In all other recognised technologies, managements appreciate the value of education coupled with industrial training given by themselves; with home and overseas competition increasing every day any alternative policy is doomed to "premature flashover." In contrast, the lighting industry is more compact and secure, in many cases forming only part of a company's many interests with little or no overseas competition. I believe this present security to be due to the efforts of a relative few whose drive, initiative and dedication is beyond all question. But who is to replace them?

For myself I am still a serious student of illuminating engineering thwarted in my first attempt by a commercial man of a world wide company who concluded that without "experience" I couldn't sell. He may indeed be right, but who was it said "nothing ventured nothing gained?"

"Let thy light so shine before men . . ." Indeed it does and with an improved colour rendering, for if the opportunity occurs or is found I shall not be slow to make a dedicated contribution to a fine industry only half a century young.

NAME SUPPLIED.

Trade Literature

AEI LAMP AND LIGHTING CO. LTD., Melton Road, Leicester. A well illustrated catalogue on Fluorescent Lighting including a separate price list. Amongt its 72 pages are details on series 2 family of fluorescent fittings for industrial and commercial use, trunking, module fittings, recessed fittings, industrial flameproof fittings, lampholders and control gear.

FALK, STADELMANN AND CO. LTD., 91, Farringdon Road, London, E.C.1. Catalogue No. 818 containing a comprehensive range of Outdoor Lanterns for lighting garages, parks, recreation grounds, roads and driveways. Brochure P.2757 illustrating the Parabeme/Colorbeme Spotlight for shoplighting, displays, exhibitions and interior floodlighting. Leaflet P.2754/59 illustrating plastic electric shades including the "Filtrair" shades.

TROUGHTON AND YOUNG (LIGHTING) LTD., The Lighting Centre, 143, Knightsbridge, London, S.W.1. Comprehensive catalogue of lighting fittings illustrating pendant and ceiling fittings, recessed and semi-recessed fittings, wall brackets, table and standard lamps, fittings for use outdoors, "Harlequin" fittings, "Tubalux" fluorescent fittings, and a complete price list.

Personal

MR. DEREK LAST and MR. KENNETH LAST have recently been appointed to the Board of Directors of the SLR Electric Ltd.

PROFESSOR MISHA BLACK, OBE, RDI, FSIA, M INST RA, a senior partner of the Design Research Unit, has been appointed consultant designer to Claudgen Ltd., a subsidiary of The General Electric Co. Ltd. It is believed that this is the first time in any country that an industrial designer of international repute has become associated directly with the illuminated sign industry.

Industrial Notes

THE BRITISH STANDARDS INSTITUTION (2, Park Street, London, W.1) has recently published a booklet entitled 'The operation of a company standards department' (price 3s.) which is sponsored by a joint advisory committee of the BSI and the Institution of Production Engineers. The BSI state that it is becoming increasingly recognised throughout industry that standards and standardisation techniques properly applied at the company level are powerful aids in raising productivity and effecting savings in design, purchasing, production and sales. Many companies now have full-time 'standards engineers' or standards departments. It is to help the growing number of firms who wish to put standards to work that this booklet has been produced. Copies can be obtained from BSI or from HM Stationery Office.

MORE THAN FIFTY ARCHITECTS, consultants, electrical engineering contractors and works engineers have accepted invitations to attend the first Atlas Lighting Design Course, which is being held in the lecture theatre of the new Thorn House showrooms. The course began on January 6 and continues for seven consecutive Wednesday evenings. Its object is to explain the basic principles and practical application of the technical data included in the Atlas Lighting Catalogue. The lectures are given by Mr. G. V. McNeill, of the Technical Sales Department of Atlas Lighting Ltd., and are supplemented by practical demonstrations of the range of equipment on display in the Thorn House showrooms.

IN DECEMBER THE LEEDS Branch of the General Electric Co. Ltd. moved into a new building in Gelderd Road about one mile from the city centre. The new building was opened by Mr. D. Bellamy, Chairman of the Yorkshire Electricity Board. The main three storey block is used for offices and showrooms; there is a single storey stores block covering 20,000 sq. ft. behind the main building.

A COMPLETE FACTORY INSTALLATION of fluorescent lamp making machinery is being exported to Melbourne, Australia, by Thorn Electrical Industries Ltd. The equipment was designed and built by Thorn's engineering subsidiary Manifold Machinery Co. Ltd. The machinery constitutes a complete installation for the making of fluorescent tubes, from the preparation of chemicals and the washing of glass parts, through to the sealing, exhausting and ageing machines. Everything is included—even the work-handling trays for components—and an interesting point is that by careful planning it has been possible to design all the large diameter ducting and fanwork to conform to the roof structure of the Australian factory.

A MAJOR INSTALLATION of mercury lamps has recently been completed in a hothouse of the tomato production unit of the Loughview Nurseries, Braniel, Belfast, Northern Ireland. Three seasons ago two mercury lamps were installed experimentally to encourage plant growth and the results were so satisfactory that the experiment was repeated on a larger scale with six lamps during the following season. Two thousand plants in all were irradiated for a period of three weeks per plant.

This season a hothouse of one hundred feet by thirty feet was equipped with thirty-six Philips horticultural fittings housing MB/U mercury lamps. During December last thirteen thousand plants were irradiated for three weeks. Of these, seven thousand were then selected for planting out while the remaining six thousand were irradiated for a further two weeks. Following this, a further batch of plants which had not been so treated were brought into the irradiation house. All the tomato seeds were planted on November 17th last and transplanted into single pots ten days later. By December 30th the maximum height achieved by non-irradiated plants was 3½ inches, while the average height of those irradiated was 6 inches, some having reached 7 inches. The growers now expect to market ripe tomatoes from the lamp-treated plants three weeks earlier than from those which have not been irradiated.

The lamps are controlled by a time switch, causing the plants to be irradiated for eighteen hours a day. The horticultural fittings are suspended from conduit along which they can be moved horizontally to the inner and outer sections of the hothouse as required.

ATLAS LIGHTING LTD. announce that as from February 1st, their Technical Sales Department, under the control of Dr. H. H. Ballin, Director and Technical Sales Manager of the company, will be reorganised to consist of four new sections handling Lighting Fittings, Commercial Engineering, Lighting Engineering and Product Engineering.

Mr. R. C. Kember will be Manager of the Fittings Department responsible for the design and technical co-ordination between production and sales of lighting fittings, accessories and control gear. Mr. J. W. Bessant, at present Atlas Lighting Engineer in Leeds, will move to Thorn House to manage the Commercial Engineering Department which will be responsible for the development of lighting through architects, consultants and large users. Mr. E. Harrison-Jones, at present in control of the London Illuminating Engineering Department, will take over control of the lighting engineers activities on a national basis. The fourth group, the Product Engineering Department, will be controlled directly by Dr. Ballin, with Mr. G. V. McNeill responsible for the development and technical liaison with laboratories and factories for fluorescent tubes and control gear; Mr. J. Stewart for tungsten lamps and fittings, and Mr. G. E. Collender for discharge lamps and gear.

THE BRITISH LIGHTING COUNCIL has arranged a one-day lighting conference for architects to take place at the RIBA Portland Place on Wednesday, April 27th. The theme of the conference is given as 'Is daylighting really necessary?' the notice stating that 'the present restrictions, which, amongst other things, were framed for the admission of daylight into buildings, do not recognise the potentialities of modern electric lighting techniques. With greater freedom the architect could plan for the more economic use of space'. The programme is in three sections. In the morning Mr. Alister MacDonald will speak on 'Designing a building'—how the planning regulations and provision for adequate daylight factors in an interior restrict the economic use of the site. After lunch Mr. W. R. Stevens will deal with 'Lighting techniques'—lighting design past, present and future; desirable brightness values associated with high illumination levels by day and by night; subjective tests; the use of colour, texture and variable lighting to avoid monotony. In the third section at 3.30 p.m. Dr. F. W. Floyd will talk on 'Humanitarian aspects'—light, colour and space to provide the best possible working conditions and maximum efficiency.

Tickets for the conference may be obtained from the British Lighting Council, 16-18, Lancaster Place, London, W.C.2.

FALK, STADELMANN AND CO. LTD. should be added to the list of firms who supplied lighting fittings in the Peter Robinson's store in the Strand which was described in the January issue of *Light and Lighting*.

TROUGHTON AND YOUNG (LIGHTING) LTD. have been awarded a certificate of exceptional merit in the RIBA Building Centre competition for their comprehensive catalogue of lighting fittings. The catalogue is to the British Standards A4 size and has a spiral binding to enable it to lie flat. This is the third year in which the competition has been held and Troughton and Young (Lighting) Ltd. has received an award each year, the only company to do so.

Postscript

AMONG THE PAGES OF *Light and Lighting* which I never fail to read are those containing the lighting abstracts. One wants to be "in the know" but the amount of technical material now published is so great that busy people cannot possibly find time to read all the full-scale articles and papers that are relevant to such a subject as lighting. Last month I was particularly interested in abstract No. 781—"A simple objective method of determining the effect of glare on the ability of the eye to see". This paper is of Swedish origin, and the method it describes involves the use of a special visual field made up of alternate light and dark bands so as to generate an optokinetic nystagmus, which changes according to glare effect. Optokinetic nystagmus means an induced oscillation of the gaze from one point of regard to another and it can occasion very distressing effects. Not very long ago I was asked to advise on what could be done to prevent certain workers in the garment industry from suffering acute headaches, nausea and even vomiting, when making up material patterned with narrow glaringly black and white stripes. It was evident on inspection that this material was inducing optokinetic nystagmus and a palliative measure was recommended which made the best of a bad job. This practical instance moves me to say that, simple as the Swedish author's method of determining the visual disability caused by glare may be, I do not envy the subjects to whom it may be applied.

GLARE SEEMS TO BE ENGAGING a lot of attention nowadays, at least by those who are striving to evolve a satisfactory method of predicting it so that lighting designers can better plan to control it. This is a good thing. Still, there is some danger whenever a particular aspect of lighting becomes a frequent "talking point" that it may get out of perspective. Preoccupation with illumination has been called, facetiously, "foot and candle" disease. Perhaps it is mildly epidemic just now, notwithstanding that, in general, illumination is more adequate now than of yore, so that the predisposing cause of foot and candle disease has lost some of its potency. But sometimes the decadence of one disease is followed by the ascendence of another. Is there a spread of "hyperglaresia" and, if so, is it because in avoiding the privation that fostered foot and candle disease we have produced a glut of glare? I doubt very much whether glare indoors is any more prevalent or severe than heretofore: on the contrary, I think it is less, and so it should be wherever lighting has been competently "engineered". It is the numerical rating and predetermination of glare that is of current interest. Glare is always a more or less "overpowering" light—the flare of a match in the dark or the window-framed sky maybe. But the new international lighting vocabulary defines it as "a condition of vision". In fact, besides defining glare generically, the vocabulary defines no less than six specific glares: three of these definitions say that glare *causes* the condition of vision and the other three say that glare *is* the condition of vision. Some further thinking seems to be desirable on this matter.

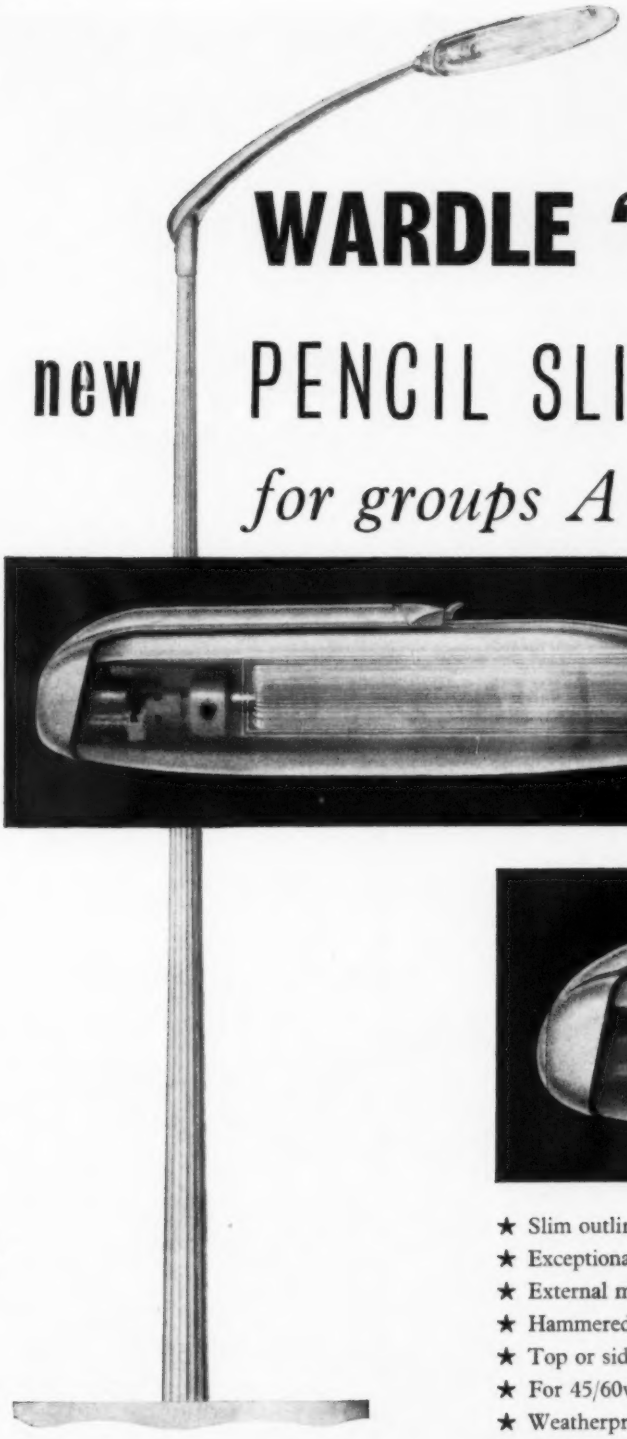
SOME FURTHER THINKING ABOUT the title of the IES would not be amiss either. No doubt it is a waste of words to suggest this but, now that the corresponding Society in France has been renamed the French Lighting Society, I wonder whether the opponents of the "British Lighting Society"—who let the initiative in title reform pass from ourselves to our cross-channel friends—are inclined to think better of it. However, in the fullness of time our Society may have the distinction of becoming the last instead of the first of such national bodies to "rectify" its name.

THERE SEEMS TO BE AN INCREASING though still scattered appreciation of the potentialities for utilising animated lighting. I do not refer to animated luminous signs but to continuously variable artificial lighting of indoor environments. Addressing the International Illumination Commission in Brussels last year on the subject of light and human values, Prof. L. Morren referred to the variety of daylight changing with the hours, as one of the great treasures of Nature. But man, he said, is no longer content only "to utilise for the joy of his eyes the light which nature offers him with incomparable generosity; the spectacular progress in the development of light sources has liberated artificial lighting from its strictly utilitarian purposes". There are no great technical difficulties in "naturalising" artificial lighting as to pleasurable variability, or in excelling nature in this respect, and the luxury of animated lighting may not be unduly costly. There have been recent developments in means for the production of decorative "live" lighting: one of these is the invention of the "luminoscope" by Nicolas Schoffer of Paris for achieving what he calls "eclairage dynamique".

THE USE OF ANIMATED LIGHTING is already familiar in theatrical practice and is becoming more familiar in an increasing number of "son et lumiere" spectacles or, as I think these are better called by one British lighting company, "auramas". Of course, the static floodlighting of picturesque buildings is also a source of great pleasure, especially when different coloured lights are used. I believe that those going to Harrogate in May for the IES Summer Meeting will have an opportunity of seeing Fountains Abbey illuminated in this way and it should be a beautiful sight.

This year's Summer Meeting looks like being very much a "down to business" one for the menfolk anyway. There is to be a triad of papers with interesting titles and, no doubt, with interesting contents. But the discussion meetings on the second day should make the Harrogate gathering truly a conference. The duration of the meeting is to be shorter than usual and this may mean there will be never a dull moment.

'Lumeritas'



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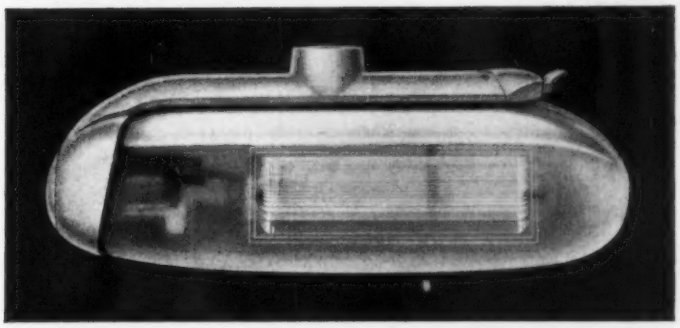

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INDEX TO ADVERTISERS

To lighting fitting designers

HERE ARE the optical properties of the I.C.I. range of opal grades of 'Perspex' acrylic sheet in convenient reference form. The diagrams show at a glance (for $\frac{1}{8}$" thick sheet) the transmission, reflection and diffusion characteristics of the materials enabling you to select the correct grade for your particular applications.

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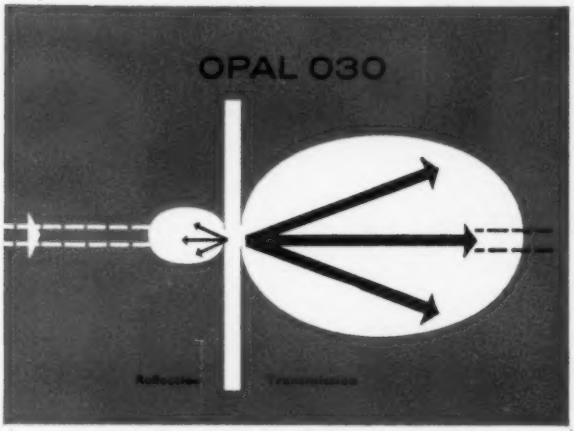
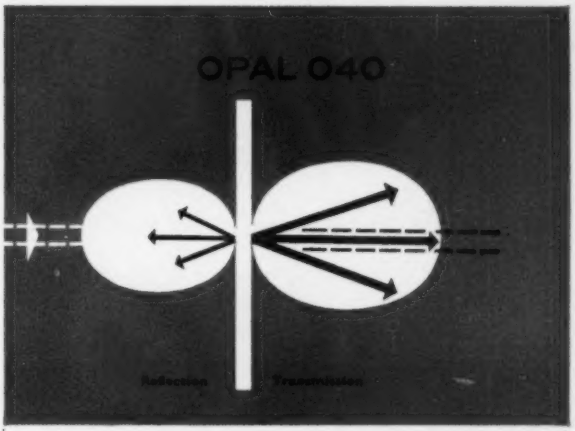
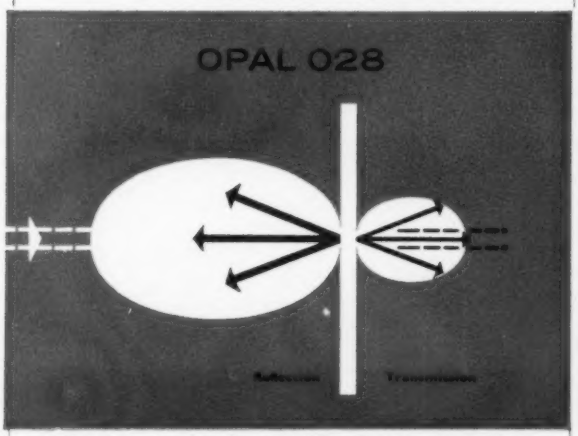


030 Transmission factor 0.78 Reflection factor 0.17
Diffusion factor 0.41



040 Transmission factor 0.55 Reflection factor 0.41
Diffusion factor 0.87



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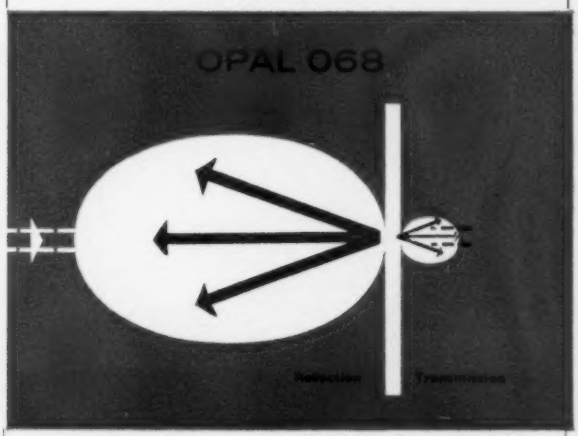
Diffusion factor 0.89



068 Transmission factor 0.08 Reflection factor 0.83
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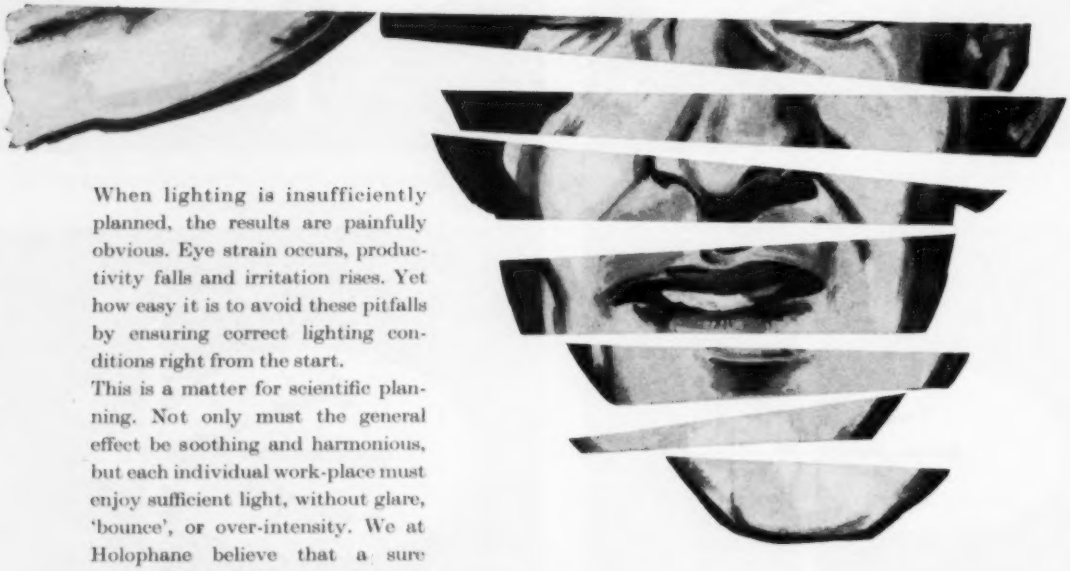

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